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Editorial Comments

The Port of Rotterdam and its Hinterland.

An Editorial Comment which appeared in the February, 1947, issue of this Journal referred to the great strides the Port of Rotterdam has made, and is making, towards the restoration of port facilities, following the destruction wrought by the Germans by aerial bombing and military demolitions. Now, in this issue, through the courtesy of Ir. F. Posthuma, the Chief Engineer of the port, we are able to present a detailed description of the problems involved in the work of reconstruction.

Following the liberation of Rotterdam by the Allied Armies in May, 1945, the rehabilitation of the port was immediately put in hand, and, despite delays caused by the prevailing shortages of materials and equipment, the work is expected to be completed by the end of 1948, and such good progress has already been achieved that the port is now able to handle about 65% of its pre-war volume of traffic. In 1938 this totalled 42,000,000 tons, and, although by far the greater part consisted of transhipments, the local general cargo trade, amounting to well over 7,000,000 tons, or about 18% of the whole, was also of considerable importance—a fact which is sometimes overlooked.

Unfortunately, as far as the Port of Rotterdam is concerned, there is still much uncertainty about the future, and the present Allied arrangements for making use of the German ports of Hamburg and Bremen when transporting goods to the industrial regions of Westphalia are viewed with great disfavour by the people of Rotterdam, who contend that their port, and to a lesser extent the Port of Antwerp, are the natural gateways for this traffic. Ever since the conclusion of hostilities, the problems of transport have been a matter of controversy between the Allied Governments, and the subject has been freely ventilated in the press. Ultimately, at the request of the Economic and Social Council of the United Nations, a thorough investigation into the problem was undertaken by the Executive Board of the European Central Inland Transport Organisation, and a report of their findings has been submitted to the Governments which are members of the E.C.I.T.O. As this report contains recommendations of vital concern to the future well-being of so great an area of Europe, it has been reprinted in full elsewhere in this issue.

A recent notice in the press states that a conference between British, United States, Dutch and Belgian officials, to decide what steps shall be taken to alleviate the position, is expected to be held this month, either in Holland or Belgium. Originally it was hoped that the conference would be held during May, but two important points have to be clarified before any further arrangements can be made. First, the United States is anxious to ascertain the difference in cost between the alternative routes and, secondly, an assurance is wanted from Dutch and Belgium officials that the unloading and transhipment of cargo in Rotterdam or Antwerp will be quicker than through Hamburg or Bremen.

Further developments will be watched with interest, as any decision must necessarily have a profound influence on both the political and economic futures of the countries concerned.

The present arbituary direction of traffic, by depriving Rotterdam of its traditional and well established function as the predominant transhipment port and chief route to and from the Rhineland has already caused drastic changes to be made in the customary commercial routine, and events have clearly proved that such changes are detrimental to the natural interplay of transport interests, both as regards their geographical and economic aspects.

Port Health Authorities.

The annual conference of the Association of Sea and Air Port Health Authorities of the British Isles, held in Belfast during the middle of last month, was attended by more than 80 delegates. The president of the Association, Mr. S. K. Henry, Belfast, was absent owing to illness and the chair was taken by Mr. J. S. Banks, Edinburgh, past president. The presidential address reviewed the history of the Association since its formation in 1898 and showed that membership now included both medical and lay representation from all the principal port authorities in the British Isles. Among the important matters considered during the past year were the betterment of crew accommodation, control of imported foodstuffs, hydrogen cyanide regulations and the National Health Service Act in its relation to the work of port health authorities. The practice of consultation with Government departments on impending legislation relating to the work of the Association had been continued and the importance of uniformity of practice throughout ports in the British Isles was emphasised. In a reference to the great increase in air traffic, it was pointed out that this had resulted in a change of title to include air ports, now an important section of their work.

During the conference several papers were read and a number of speeches delivered, and of the many pertinent points made, we cordially agree with the remarks by Councillor Banks that not sufficient is known by the general public of the excellent work being done in a quiet, efficient manner by port medical officers, to whose vigilance, the freedom of the British Isles from smallpox, cholera, typhus and similar diseases is largely due. In this connection we suggest that more publicity should be given to the work of the Association. We also endorse the statement of Alderman W. Cecil McKee that port sanitary authorities have a most important part to play in the health services of the nation and it is necessary that they should work to a standard method if the best results are to be achieved.

Editorial Comments—continued

Decasualisation of Dock Workers.

In our issue for April last there were given particulars of a Draft Permanent Scheme for British Dock Labour issued by the Minister of Labour and National Service in connection with which it was announced that a period of 40 days would be allowed for the lodgment of objections to the scheme. These were duly received and have been under consideration by Mr. John Cameron, D.S.C., K.C., who was appointed by the Minister to hold an Inquiry into them. It is now announced by the Minister that he has been notified by the National Joint Council for the Port Transport Industry that they have been unable to reach agreement on the question of the amount and basis of calculation of the guaranteed payment to be made to dock workers under paragraph 14 of the draft Order for implementing the scheme and that the Clause will be considered in the course of the above statutory Inquiry which Mr. Cameron has been appointed to make.

In the meantime, the Minister feels the need of impartial advice as to the basis of calculation of a guaranteed payment under a Scheme made by virtue of the provisions of the Dock Workers (Regulation of Employment) Act, 1946. This guaranteed payment is to be made to those dock workers to whom the scheme applies, who are available for work during periods in which employment, or full employment, is not available for them. He has, accordingly, appointed a committee of five under the chairmanship of Sir Hector J. W. Hetherington, M.A., LL.D., to look into the matter and make recommendations. The other members of the committee are Messrs. Victor R. Aronson, M.A., B.C.L., E. W. Bussey, C.B.E., W. Tudor Davies, B.A., B.L., and A. H. Mathias.

Radio Aids to Navigation.

The second international meeting on Radio Aids to Marine Navigation, held in the U.S.A. from 28th April to 9th May last, brief reference to which was made in our last issue, was attended by delegates from 31 nations. Among the papers read at the conference, much importance was attached to the one presented by Captain R. W. Ravenhill, Director of Navigation & Direction, Admiralty, excerpts from which appear on page 56 of this issue.

At the final meeting of the conference, a number of conclusions, recommendations and views were adopted, the majority, of course, dealing with navigational problems affecting shipping at sea. As far as Port Authorities are concerned, the following points should be of interest. A resolution on Radar concluded that high resolution shipborne radar with ancillary devices, having suitable and approved minimum performance capabilities and operated by qualified personnel, is a device having wide applicability to maritime use for anti-collision, pilotage, above water obstacle detection, and general position fixing within range of suitable fixed radar targets, either natural or artificial.

It was concluded that a shipborne radar with reduced performance requirements and generally understood to be an anti-collision radar against large ships is completely inadequate for the full requirements for position fixing and navigation in coastal and pilotage waters.

It was strongly recommended that a suitable device be developed to provide accurate and positive identification by radar of navigational markers, dangers, and shore features. It was particularly recommended that reflectors should be installed on selected navigational markers in order to facilitate the differentiation of these markers from other echoes, including sea return.

It was recommended that a solution to the problem of increasing the echoing efficiencies of small vessels is of immediate importance, and that the study of the conditions under which such increased echoing efficiencies should be required on small vessels should be undertaken. Should such study prove successful, it would become desirable that the Conference for Safety of Life at Sea should consider the use of such a device.

It was concluded that a chart comparison unit is a desirable but not essential auxiliary device, and that the question of charts for use with radar should be co-ordinated with the chart requirements for other navigational aids. Shore-based radar has many possible applications to maritime usage and operational trials should continue.

The first of the recommendations on position fixing systems laid down that the development and adoption of equipment and systems for maritime navigation should be guided by a table showing depth of water, distance from nearest danger, accuracy required and time available to obtain position.

In considering systems of the short and medium distance category, the conference concluded that Decca appears to provide a position fixing system of an accuracy which meets the mariner's requirements and therefore should be improved and expanded.

A particularly important recommendation was that, for the purpose of making information available to the user upon request, and to have such information available for an appropriate future international conference or organisation, an international Fact Finding Committee be set up, comprising scientific experts, to obtain and co-ordinate numerical data on the performance of various radio navigational aids, and that if a future appropriate international body should establish an organisation appropriate for the continuance of such work, the functions and data accumulated by the standing committee should be absorbed by such international organisation.

Finally, it was recommended that, in view of the importance of radio aids to safe marine navigation, adequate provision should be made to meet the requirements of mariners at the forthcoming International Telecommunications Conference.

The City of London Reconstruction Proposals.

The Final Report of the Consultants, Dr. C. H. Holden and Prof. W. G. Holford, on Reconstruction in the City of London was recently before the Court of Common Council, when it was referred to the Improvements and Town Planning Committee for consideration. As was pointed out in our editorial comment in September, 1946, whilst the rebuilding of the City of London is of general interest, the proposals affecting the wharves between Blackfriars and London Bridge, the widening of Upper and Lower Thames Streets, and the improvement of the arteries giving access to the port, and particularly the dock area, are the only features about which comment is pertinent in this Journal. Summarising these, it is proposed to widen Thames Street along the whole length, part of it being terraced to maintain it at the upper (or office) floor level, the service road at warehouse level being retained. The proposals in the vicinity of St. Paul's Cathedral for a precinct and ceremonial water approach involve a radical change along the river front. The plans attached to the Report show a pedestrian "walkway" along the wharf front, extending only between Blackfriars and just west of Southwark Bridges. This seems to suggest that the original plans for a riverside walk along the City waterfront have been drastically modified. The proposals for new streets and the alignment of old streets include several new circuses or squares.

It should be emphasised that as the Town & Country Planning Bill contains provisions for the transfer of the City's planning powers to the L.C.C. (notwithstanding that the Corporation of London are recommended to submit the plan to the Minister, under the 1944 Act), it seems likely that further delay will arise before the plans are finally approved by the appropriate authority, whoever this may be.

On the broader issues, the Plan is the result of scientific study of the City's accommodation and traffic problems, and, once it is agreed, the City interests will have a charter to which building projects can be designed. In this connection, it is to be noted that, for the first time since the war, proposals are before the Corporation regarding the extent of the areas to be made "declaratory areas," i.e., subject to compulsory acquisition for planning and development.

The problem of execution and the question of the cost of the proposals remain, but a basis for reconstruction has been laid down with skill and vision.

We endorse the view expressed in the Report, "finally it is evident that the river and the roads and railways serving the City are only terminals or links in a system of communication which spreads over the whole region and reaches to the sea." It is to be hoped that this consideration will be kept in the foreground in implementing the City Plans.

The Port of Rotterdam

Transformation from Dyke Village to World Port

By Ir. F. POSTHUMA (Engineer of the Port).

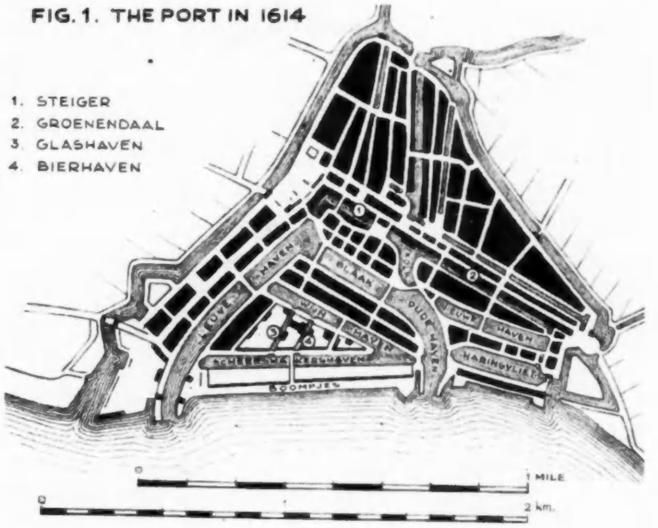
The History of the Port until 1872

AT the beginning of the Christian era the Romans seem to have used a busily-frequented ferry at the site where Rotterdam is now situated.

After the fall of the Roman Empire peace and quiet returned to the delta of the rivers Rhine and Meuse. The few inhabitants of the marshy banks principally applied themselves to fishing, which finally became so important that in the Middle Ages several villages arose along the primitive river-dykes, among them being Vlaardingen, Schiedam and Rotterdam. Of these, Rotterdam, later than many other Dutch towns, obtained civic rights in 1340. In the second half of the fourteenth century the first basins were excavated (Steiger, Groenendaal and Kolk), see Fig. 1.

Fishing, and especially herring fishing, remained the base of industrial life until about 1550, when, besides the export of herrings to the Baltic, the import of grains; potash and flax from these parts and the export of agricultural produce to the North of

FIG. 1. THE PORT IN 1614



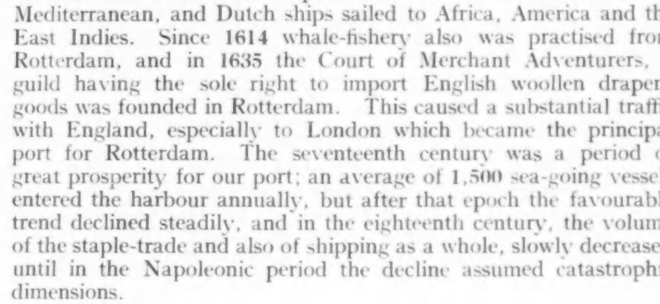
France also became important. This sea-traffic involved a busy inland navigation to Cologne, Amsterdam and Flanders. The little town extended, and in such a manner that the present natural bend of the river was sharpened. Thus a situation was produced in which the direction and speed of the river-current prevented accretion at the moorings of the ships along the right bank and in the dock-basins debouching therefrom. This favourable situation is one of the reasons why Rotterdam has been able to develop into what it is now—not Schiedam which is older than Rotterdam or Delfshaven, founded by Delft, at that time a mighty town—and has become a world port. At present Delfshaven is a district of Rotterdam and the Rotterdam docks now extend far beyond Schiedam, because dredgers have been able to maintain the necessary depth of water at these western docks.

In the last decade of the sixteenth century, sea-borne traffic rapidly increased and the available moorings along the river and in the oldest basins became insufficient, so that the first important port extension was started in 1574. These works were finished in 1614. Successively Blaak, Niepwe Haven, Haringvliet, Leuvehaven, Wijnhaven, Scheepmakershaven, Boompjes, Glashaven and Bierhaven were completed (see Fig. 1). Fishing was no longer the most important source of income, and the Municipality assigned the Haringvliet, situated outside the town-centre, as the site for this trade. Along the new basins large warehouses arose for the storage of goods and Rotterdam became an important staple town.

Fig. 2. Floating Cranes unloading ships (October 1946).

Following the traffic to the Baltic and France, even brisker commercial relations developed with the countries round the Mediterranean, and Dutch ships sailed to Africa, America and the East Indies. Since 1614 whale-fishery also was practised from Rotterdam, and in 1635 the Court of Merchant Adventurers, a guild having the sole right to import English woollen drapery goods was founded in Rotterdam. This caused a substantial traffic with England, especially to London which became the principal port for Rotterdam. The seventeenth century was a period of great prosperity for our port; an average of 1,500 sea-going vessels entered the harbour annually, but after that epoch the favourable trend declined steadily, and in the eighteenth century, the volume of the staple-trade and also of shipping as a whole, slowly decreased until in the Napoleonic period the decline assumed catastrophic dimensions.

Fig. 3. Typical Cross-section of a Quay with sheds.



After the French domination, the staple-trade only slowly recovered. On the other hand the transit-trade via Rotterdam rapidly became more important, the stream of goods between England and France on the one side and the German industrial areas along the Rhine and the Ruhr on the other, being sent via Rotterdam as the cheapest and quickest route. Attempts to deprive Rotterdam of its favoured position always failed by reason

Port of Rotterdam—continued

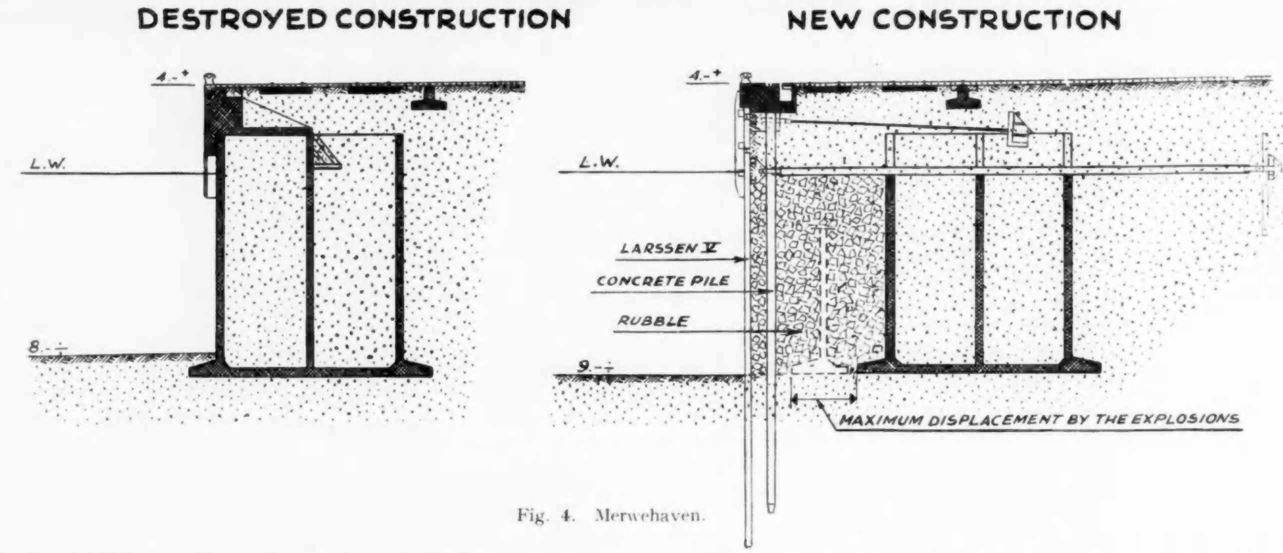


Fig. 4. Merwehaven.

of its excellent natural situation. Once more the harbour accommodation had to be enlarged, but through the silting-up of the entrance of the River Meuse, access to the port no longer came up to the requirements of traffic. Several enlargements of a minor nature were carried out, but more extensive plans had to wait for the improvement of the communication with the sea, which was put in hand in 1866.

Developments after 1872

In 1872 direct communication of Rotterdam with the North Sea, in which no obstacles of bridges or locks are encountered, was finished. Sea-going vessels no longer had to find their way laboriously through the delta and goods no longer had to be transshipped, but at all times ships could pass without hindrance.

The development of bulk-cargo transport increased appreciably, the extension of the harbour keeping pace with it, especially on the left bank of the Meuse. The Rijnhaven was completed in 1894 and the Maashaven followed in 1905. The Waalhaven with an area of 750 acres was started in 1906. In 1929 and following years the existing petroleum installations were transferred to the first Petroleumhaven. Immediately after that it became necessary to build the second Petroleumhaven. Also on the right bank important works were carried out, such as the Merwehaven in 1932. The Rotterdam dock area had grown to the extent indicated in the Plan on the next page.

Originally, the Spoorweghaven and Binnenhaven were built on behalf of a private concern, but when the latter got into financial difficulties in 1882, the dock property was taken over by the Municipality which, since that date, has carried out and financed all further extensions of the harbour accommodation and consequently owns the basins, quay walls, landing sites and approaches. Shipowners, ship brokers and stevedores can rent sites and quay walls on long lease from the Municipality and provide, at their own expense, the installations necessary for their purpose. Not only by allocating dock space, but also by letting sheds, sites, cranes and dry docks which are owned by them, the Municipality can exercise some influence on the course of things. The tariffs which are applied have a certain cost-regulating function. By means of these installations the Municipality also protects the smaller concerns whose resources are less than those of the larger companies.

Of the greatest importance also are the port dues levied upon sea-going vessels visiting the port. These are charged in such a manner that they do not weigh heavily on ships which discharge a few consignments only. This encourages larger ships to visit the port and also is the reason why all basins in the last 20 years have been built with a depth of 10 metres. The range of tide is 1.50 m. Though each dock basin has excellent road and rail communications, transport by lorry and by rail has continued of little importance because of the dense net of waterways throughout Holland and the easy communications via the Rhine with the German hinterland. Yet in the building of quays and sheds allowance was made for goods transport by motor trucks with Diesel engine traction which was expected to expand considerably.

Attention has already been drawn to the excellent geographical situation and to the safe and swift communication with the sea. The New Waterway has a mean average depth of 11 metres below low water which is maintained chiefly by the action of the tide. It

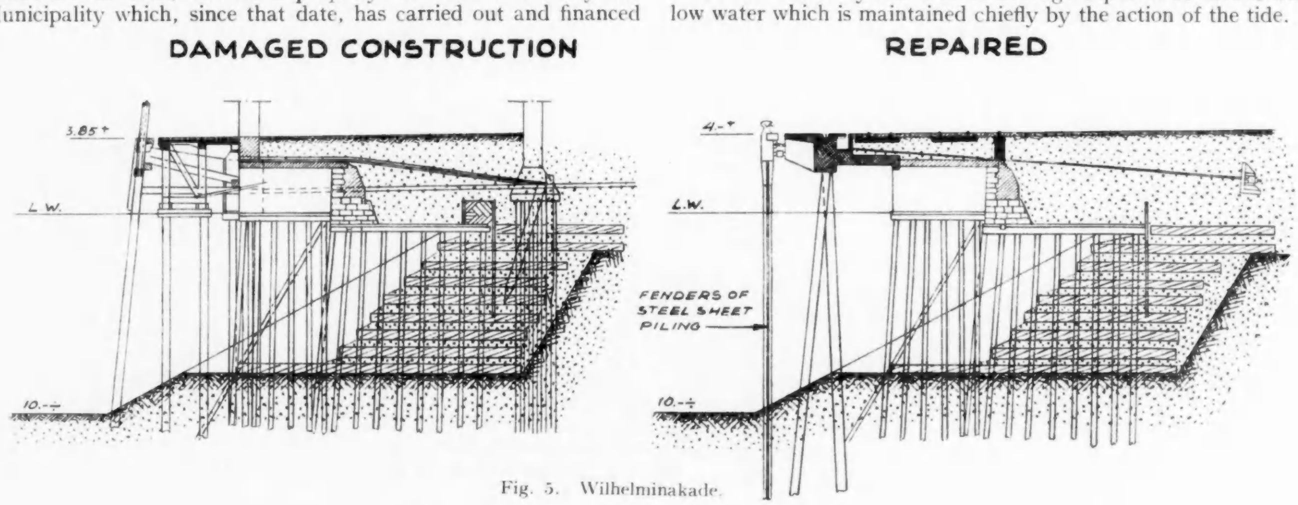
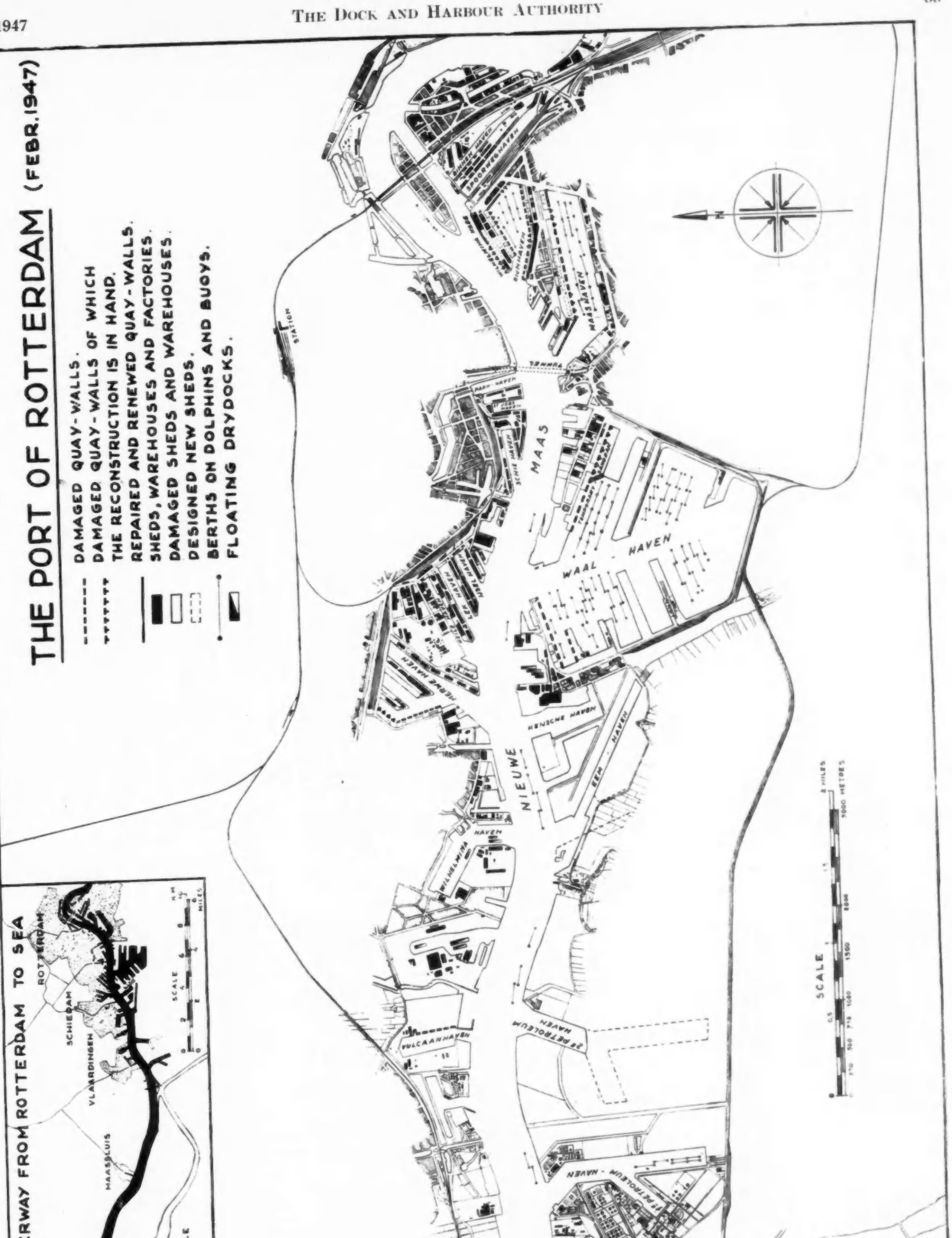


Fig. 5. Wilhelminakade.


THE PORT OF ROTTERDAM (FEBR. 1947)
DAMAGED QUAY-WALLS.
DAMAGED QUAY-WALLS OF WHICH THE RECONSTRUCTION IS IN HAND.
REPAIRED AND RENEWED QUAY-WALLS.
SHEDS, WAREHOUSES AND FACTORIES.
DAMAGED SHEDS AND WAREHOUSES.
DESIGNED NEW SHEDS.
BERTHS ON DOLPHINS AND BUOYS.
FLOATING DRYDOCKS.
THE WATERWAY FROM ROTTERDAM TO SEA
HOEK VAN HOLLAND
MAASSLUIS
VLAARDINGEN
SCHIEDAM
ROTTERDAM
BRIELLE
SCALE
MAAS
NIEUWE
WAAL - HAVEN
EEM - HAVEN
WILHELMINA HAVEN
VULCAANHAVEN
2e PETROLEUM HAVEN
PETROLEUM - HAVEN
OUDE MAAS
PARK-HAVEN
TUNNEL
STATION
SPOORWEGHAVEN
MAASHAVEN
SCALE

Port of Rotterdam—continued

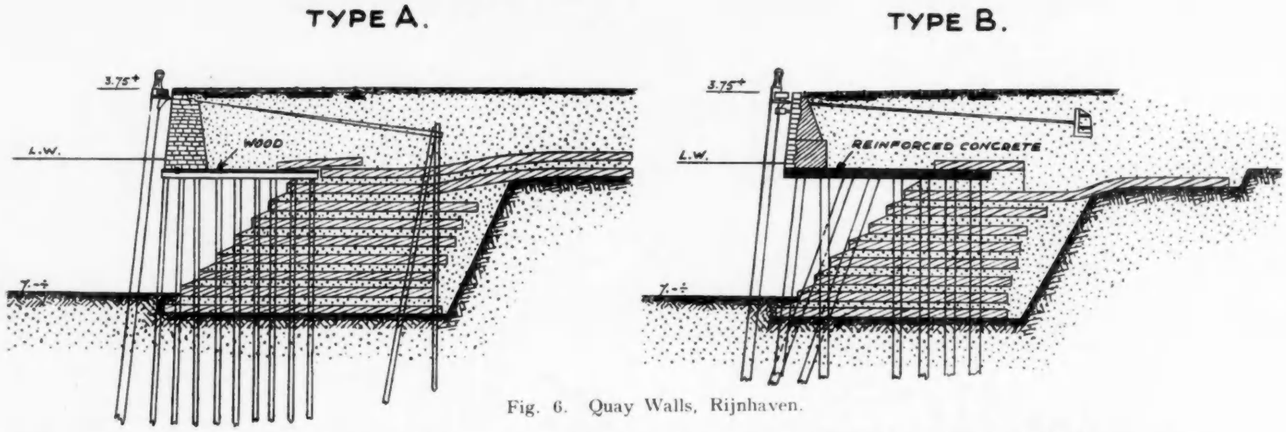


Fig. 6. Quay Walls, Rijnhaven.

was, however, understood that adequate equipment was equally indispensable.

Before the first world war the port was already equipped with transporters, the number of which gradually increased to 28, including some with a loading capacity of 20 tons. The floating cranes for transhipment at buoy moorings developed into level luffing cranes, or floating transporters with so great a radius that the crane was no longer placed between the sea-going vessel and the Rhine barges, but on the outer side so that during the transhipment the same swinging movement could be executed as by a loading bridge on the quay. (Fig. 2).

Examples of rapid transhipment are:

1. 8,700 tons of ore discharged in 7 hours (1,242 tons per hour).
2. 4,835 tons of coal in 3 hours 25 minutes (1,415 tons per hour).
3. 8,100 tons of grain within 8 hours (1,040 tons per hour).

In 1938 the goods traffic of Rotterdam to and from the continents was divided nearly as follows:

Fig. 7. The reconstruction of the quay-wall behind temporary sheet-piling.

	Imports	Exports
Europe and the Countries around the Mediterranean:		
Bulk cargo	13,500,000 tons	11,000,000 tons
General Cargo	1,500,000 tons	2,500,000 tons
North and South America.		
Bulk cargo	5,900,000 tons	1,300,000 tons
General cargo	800,000 tons	400,000 tons
Asia and Australia:		
Bulk cargo	500,000 tons	nil
General cargo	1,400,000 tons	400,000 tons
Remaining Africa:		
Bulk cargo	650,000 tons	50,000 tons
General cargo	250,000 tons	150,000 tons

The total goods traffic in 1938 amounted to: 42,000,000 tons.

Though the bulk cargo transport, consisting mainly of the transhipment of coal from, and ore to, Ruhr area, constituted the principal trade of the port, yet the transport of about 7,500,000 tons of general cargo was also important, and it is unfortunate that this aspect of Rotterdam's trade is so little known. This is partly caused by the fact that the warehouses are not all situated close together. By a special custom control system the warehouses were built where they are most useful to the employer, and it was not necessary to congregate them within a free port area. This customs control system works so well in practice that the port is justifiably known as freer than a free port.

Besides the warehouses mentioned above it is also possible to store goods in the dock sheds or on the quays without the necessity of complying with legal formalities, because it is customary for the ship's agent to be in possession of the licences required for this purpose. The majority of these sheds are of a very modern construction provided with roof hatches and wholly constructed of steel and reinforced concrete; consequently they are fireproof. The quay cranes at Rotterdam all work electrically and to a large extent are level-luffing cranes with a radius of 25, 30 and 36 metres and a lifting capacity of 5 tons. (Fig. 3).

Rotterdam takes a special place as a petroleum port. The storage capacity for bulk liquid before the war amounted to 900,000 tons; moreover refineries and a gasolene cracking installation have been built. Now 730,000 tons can be stored and the factories are fully working again.

Thus before the second world war, Rotterdam had become a port of call for 150 regular lines and annually was visited by more than 15,000 sea-going vessels and 200,000 river craft, including Rhine barges of up to 4,000 tons. It was not only a port of transhipment, but also an important distribution centre for all kinds of goods, including grains, oil and fats, semi-tropical fruit, bananas, coffee, tobacco, products from the Indies, metals, cotton, wool, timber and hides. In one of the shipyards the luxury passenger ship, the "Nieuw-Amsterdam" (36,000 B.R.T.), had been completed, and the port's ship-building and ship-repairing industry added to the prosperity of the whole country.

The Port of Rotterdam during the War

On the 10th of May, 1940, the activity in the port was totally paralysed by the invasion of the Germans. On the 14th of May,

Port of Rotterdam—continued

1940, after the bombardment of the old city when 27,000 houses went up in flames, the resistance was finished for the European part of the Kingdom and an occupation, which was destined to last for 5 years in ever-growing severity, commenced. Though in the first years of the occupation the transport of ore was still of some importance, the traffic soon was reduced to a few ships, single or convoyed, which were often, directly after leaving the New Waterway, heavily and mostly successfully attacked by Allied submarines, surface ships or bombers. When, at last, the Germans realised that in this direction the port was of no use to them, they started dismantling cranes and loading bridges and conveyed them, together with several floating cranes, to Hamburg and the German and Polish ports on the Baltic. During this operation, however, they were disturbed by the rapid advance of Field Marshal Montgomery's armies, and only then, in September and October, 1944, the "furor teutonicus" broke out in full measure. With the characteristic German thoroughness the quay walls of several basins were demolished and with the quay walls, the cranes and, totally or partly, the sheds and warehouses disappeared into the water. Probably because the progress of the Allied armies after the battle of Arnhem had been checked, as far as the Netherlands were concerned, the destruction was stopped as suddenly as it had begun. The result was that about one-third of the port only had been destroyed. After making many preparations for still greater destruction, the Germans waited for the attack on the fortress of Holland. This, however, did not come, for before that time the German army capitulated because of the great Allied successes in the heart of Germany. The Netherlands and especially Rotterdam, had suffered seriously, but they were not broken. On the 6th of May, 1945, the first English food ships sailed into the New Waterway; discharge started immediately and was carried out smoothly, for the largest part of the harbour was still intact.

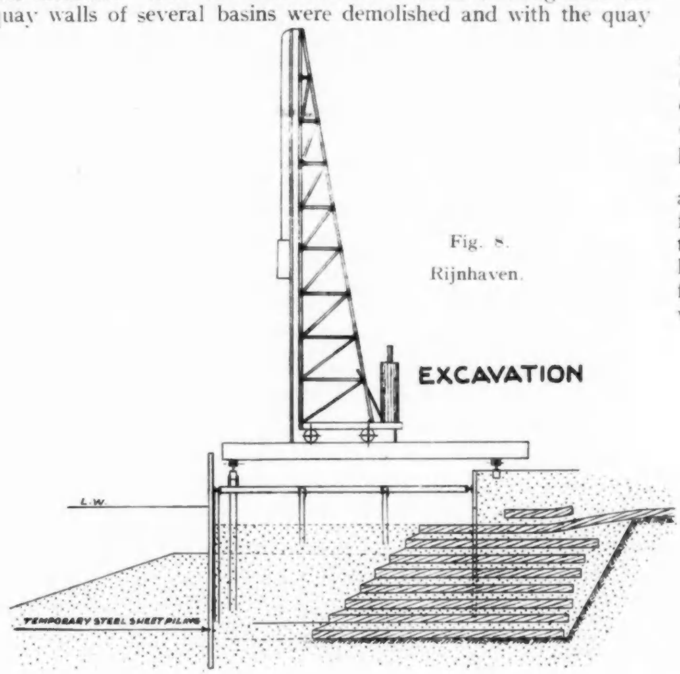
The Port of Rotterdam after the Liberation on the 7th of May, 1945

Thanks to the help of English salvage companies, provided with salvage craft, it was possible to start immediately the clearing away of the scuttled ships which were partly used to block the entrances of some dock basins. These parts were soon cleared to such an extent that navigation could take place unhindered. At present practically all wreckage has been raised and partly made good.

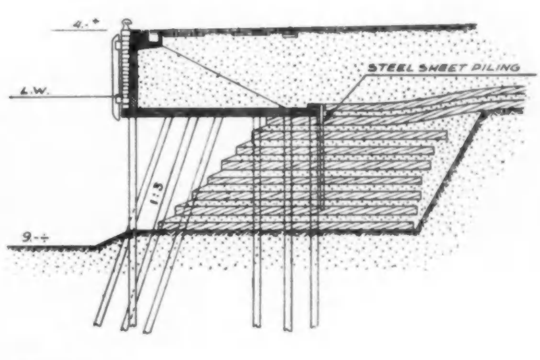
At the same time the clearing of the destroyed quay walls, sheds and cranes were tackled. The clearing away of the underwater fragments of the quay walls was carried out up to a weight of 25 tons by heavy floating grab cranes and a dipper-dredger. The heaviest fragments up to a weight of 130 tons were raised by floating derricks after the ropes had been fixed by divers. This voluminous clearing work has almost been finished now.

Fig. 8. Rijnhaven.

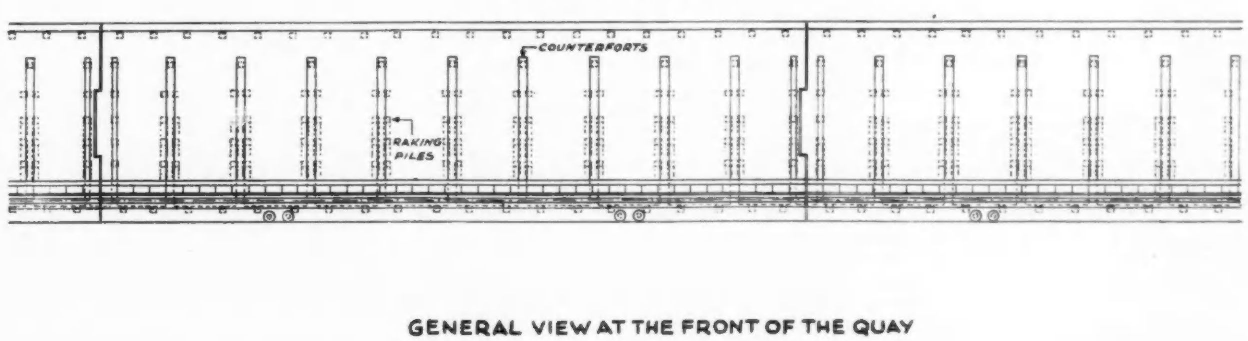
EXCAVATION



THE NEW QUAY-WALL



PLAN OF THE QUAY



GENERAL VIEW AT THE FRONT OF THE QUAY

Port of Rotterdam—continued

In the meantime, the different methods of rebuilding were planned so that the clearing away could be immediately followed by the reconstruction. The private companies, the sheds and warehouses of which were damaged or destroyed, naturally did not stand out of it. Here also the reconstruction is at its height and several sheds have already been rebuilt or repaired.

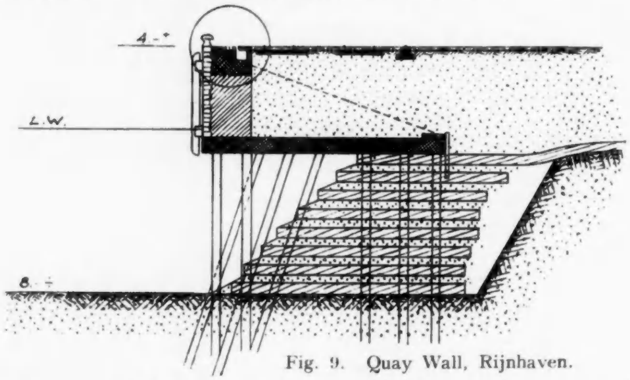


Fig. 9. Quay Wall, Rijnhaven.

The work of clearing and the reconstruction of the quay walls are being carried out by a combine of eight contractors, among whom are three English firms. Among other things this combine have the following materials at their disposal:

15 compressors (with 90 hammers);
5 floating cranes with grabs;
1 dipper-dredger;
1 suction dredger;
4 floating derricks;
5 big pile drivers;
6 big floating pile drivers;
1 floating concrete installation;
9 concrete mixers;
17 pontoons
50 barges;
5 diving installations;
1 diving bell with work ship.

In order to have the work executed as smoothly as possible the Government have made it possible to expropriate the destroyed warehouses, sheds and cranes owned by private firms. In practice the result of this arrangement was such that it was left to the private firms either to clear away the destroyed or damaged properties themselves, within a fixed time, so that the rebuilding of the quay wall was not delayed, or to have their properties expropriated, in which case the Government paid the cost of dismantling. In the first case compensation will be paid, the calculation being based on the amount of war damage; in the second case the cost is based on the value of the whole object on the 10th May, 1940.

The methods of reconstruction applied for the quay walls in the damaged dock basins will now be discussed.

1. Lekhaven

Here the damage was not serious, so that in the middle of 1946 reconstruction could be considered finished. There are no constructive details to be recorded.

2. The Merwehaven

As will be seen in the Plan, this basin branches into three parts, of which only the most western quay wall with a length of 760 metres was demolished by charges of about 1,000 kg., set in front of the wall on the floor of the basin. Through the explosions, the relatively light construction of caisson work located here was hurled from its place. Further, the front walls were breached open, and here and there, the back wall was also heavily injured. Measurements and examination by divers led to the conclusion that the old construction had been irreparably destroyed. In order not to give the site behind the quay wall which is to be built, an uneconomical width, and not to narrow the basin itself unnecessarily, steel sheet piling has been chosen here for the new construction. (Fig. 4). This wall is situated 6 metres before the front of the old quay wall and has been anchored to a short continuous wall of steel sheet piles. To support the crane-rail, a beam of reinforced concrete has been placed which is not only carried by the sheet piling, but also by a row of piles of reinforced concrete. The bollards are anchored independently. The fenders are composed of fixed wooden frames. The sheet piling is filled up with brick refuse belonging to the houses destroyed in May, 1940. Because of the low specific gravity of these broken bricks, and the high angle of friction, the pressure on the sheet piling is considerably diminished. After the concrete piles had been rammed in, the steel sheet piles were driven. With the aid of temporary steel crosswalls, trenches were formed which were drained separately, after which the anchorage was placed and the concrete beam made. In the concrete backing the connections for water, electricity and telephone are placed.

In the real dock area the sub-soil up to about 16 metres under low water is composed of soft clay and peat, this in contrast with the sites, now reserved for industry, of which sites the sub-soil totally consists of sand. In the construction of the original quay walls in the Merwehaven, the unsuitable sub-soil was completely dredged away and replaced by sand, so that the steel sheet piling is now wholly standing in sand which however, unfavourably affects the durability of the steel.

3. The Wilhelmina Quay

In order to ascertain whether the selected type of bomb was heavy enough, and also what distances apart they had to be placed, the Germans by way of experiment exploded two bombs before the Wilhelmina quay by which two big holes of 35 metres length were caused.

This quay wall, 700 metres in length, at which the liners to New York usually moor, had twice already been brought forward into the river in order to acquire a greater depth of water. (Fig. 5). As these alterations no longer come up to modern requirements, it was decided to pull down part and to build a new front which in the first setting forward was connected with the original quay wall by means of a slab of reinforced concrete. The new construction itself consists of a beam of reinforced concrete, with which the slab above-mentioned is incorporated, and is provided with a console. In front of the new quay wall, bearing against the console, fenders are placed composed of two welded steel sheet piles. The long piles of pitch pine, as used in Rotterdam before the war, were not available so that an experiment had to be made. These fenders have been used for half-a-year now and as far as can be ascertained the experiment can be considered successful.

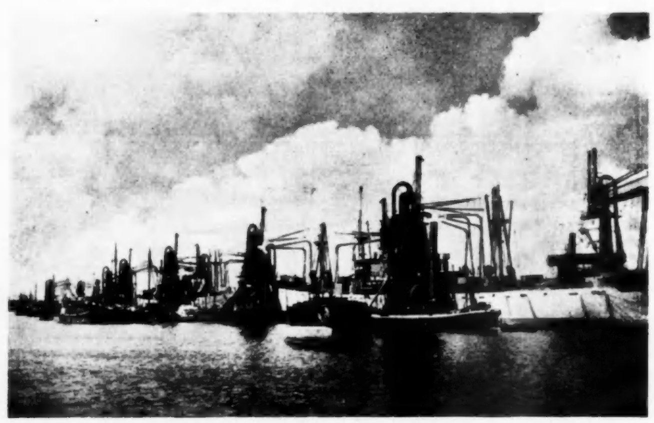


Fig. 10. The Maashaven with elevators discharging grain vessels (October 1946).

Where the old quay wall had been blown up, a new one has been constructed consisting of a floor of reinforced concrete on piles of the same material with the same front.

The total length of 700 metres will be ready in the middle of 1947; at present 350 metres have been put into use as well as a

Port of Rotterdam—continued

newly-built shed of 170 x 30 metres, built by the tenant of the site.

4. The Rijnhaven

Of the destroyed or damaged dock basins the Rijnhaven is the oldest. It was built in the years 1887-1894 and provided with quay walls, as indicated by type A (Fig. 6), resting on a wooden floor on thin wooden piles. In order to give the talus a steeper slope and to stabilise the whole a fascine-work w as first made.

It appeared that this type was not everywhere proof against the horizontal pressure of the soil and the surcharge. The piles which, moreover, were all standing vertically, had too small a bearing power and the wooden floor was not strong enough. For several hundreds of metres this foundation had to be replaced by type B. (Fig. 6). Between the old piles, which were scrapped, heavier wooden piles of 40 x 40 centimetres were driven, with heads bedded in a floor of reinforced concrete of 50 centimetres resting thereon. In order to protect the wooden piles from rotting, this floor which is lying under low water, has been made in a diving bell, in which the water level was lowered by compressed air. A floor section made in the diving bell had a length of 20 metres; the apertures between the floors being covered up by a tile.

Type A was completely destroyed by the explosions and was repaired in sections of about 120 metres behind a temporary steel sheet-piling. (Fig. 7). The new quay wall is a construction of reinforced concrete with counterforts of which the details are sufficiently indicated in Fig. 8.

Naturally Type B was better able to withstand the effect of the explosion. A large part of the heavy wooden piles after testing appeared to be still useful, while it was found the old floor of reinforced concrete could, in some places, be used in the new work. The unreliable or destroyed wooden piles have been substituted by concrete piles. As for the raking piles which were used, it seemed desirable to place them in front of the old wall in view of the great number of piles which had been broken off so deeply in the soil that they could not be removed.

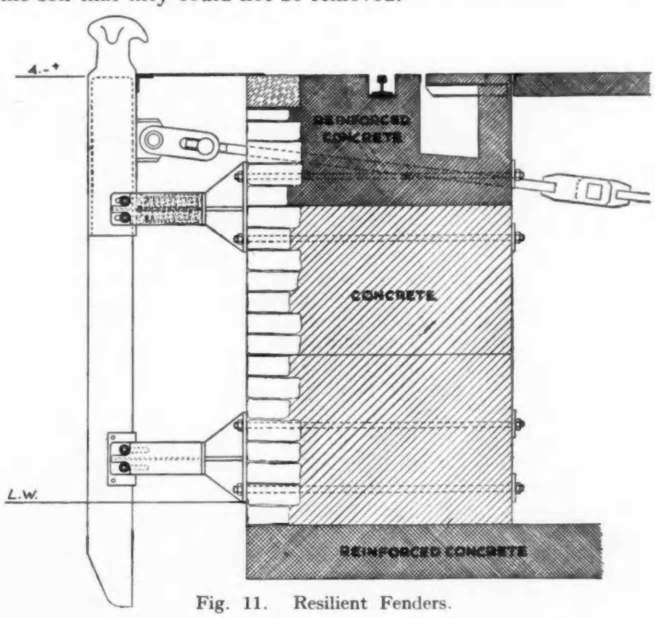


Fig. 11. Resilient Fenders.

Because the Rijnhaven will also have a greater depth than the old basin, one raking pile more had to be introduced, and it was also necessary to build the new quay wall 3 metres forward. Using a part of the old wooden piles of Type B made it impossible to apply the distribution of piles necessary for a wall with counterforts, so that for this purpose the construction sketched in Fig. 9 has been designed. In this type counterforts have only been placed near the bollards for the purpose of taking the pull of the mooring ropes.

The order of operations, after the destroyed or damaged quay walls, sheds and cranes have been cleared away is as follows: first a sand mound is formed enabling shorter steel sheeting piles to be used which find support in this sand mound.

Heavy substantial struts transfer the water pressure against the outer sheet piling to the soil which lies behind. Then the

Fig. 12. A part of the Waalhaven in which the water level is lowered 7 m.

concrete piles are rammed in the dried-out excavation, the floor is made, the struts transmitted thereto and the quay wall constructed up to above high water. Finally, the outer steel sheet piling is drawn to be used again elsewhere. The last sheet piling is cut and bedded into the concrete floor in order to prevent the sand behind the new wall from filtering into the dock basin. In the Rijnhaven 200 metres had been completed by 1st February, 1947, and the reconstruction of a further 500 metres is now in hand. At the present rate of working the totally-destroyed length of quay walls in this basin of about 2,000 metres will be completely replaced towards the end of next year, when it will be possible to bring a totally modernised dock basin into use. This is very important in view of this basin's favourable situation in regard to the town.

5. The Maashaven

This basin, now used as before the war for discharging grain vessels at berths with the aid of elevators (Fig. 10) has been built later and in view of the experience gained with the Type A described for the Rijnhaven here Type B has been constructed with the help of the diving bell. Moreover, the soft clay and peat layers were replaced by sand. The new quay wall is practically the same as is indicated in Fig. 9. Through the smaller number of pile stumps and the maintenance of the original depth of the basin a setting forward of 1 metre sufficed. Half of about 1,800 metres of quay wall which had been destroyed is being repaired in a similar manner to the Rijnhaven wall, behind a temporary steel sheet piling. The remaining part is built with the same diving bell with which the old quay wall has been constructed. It had been preserved in view of possible repair works, and the damaged super-structure of the proper quay wall, has been demolished with the aid of the diving bell placed on the old floor. After demolition, the bell is removed and used somewhere else, after which, in substitution for the damaged wooden piles, concrete piles are driven in. When this pile-work is finished, the diving bell is returned to its former place for the making of the new platform. Then the bell is removed and on the floor prefabricated quay wall blocks are set. By this means the work is

Port of Rotterdam—continued

raised sufficiently high above low water to enable the wall to be completed normally.

In contrast to the fixed timber fenders in the Rijnhaven, resilient fenders are applied in the Maashaven (Fig. 11), also because the strut piles protrude in front of the wall. In the Waalhaven this construction, for which no long wooden piles are needed, has already been applied successfully.

In the Merwehaven on the 1st February, 1947, 600 metres had been totally renewed while the reconstruction of 500 metres is in hand. It may be expected that the quay walls in the Maashaven with a total length of 1,800 metres will be ready in the second half of 1948.

In the damaged dock basins, the Municipality does not simply return the sites to the former tenants after the quay wall has been repaired. In consultation with all interested a more efficient distribution of the quays is aimed at.

6. The Waalhaven

Here reconstruction has been rendered difficult by the very extensive clearance work necessary. Twelve large and two small transporters have been scrapped or, if they were reparable, dismantled, which required still more time. The clearing under water of the destroyed quay walls consisting of a caisson construction, was here principally carried out by the dipper-dredger. This implement is more suited for the clearing away before the damaged front wall of the caissons than for a quay wall on pile foundation, because in this latter case it is possible for the dipper to force the stone fragments between the old pile stumps in consequence of which difficulties arise in driving the new piles.

After the clearing away had been finished, it did not appear easy to form from the divers' reports a correct estimate of the damage to the caissons under water. It has, indeed, been stated that these caissons in contrast with those in the Merwehaven, had barely moved or had not moved at all. This is probably because, in this instance, the charges were not thrown into the water in front of the caissons, but were placed in holes behind the wall. So the suction on the front of the quay wall, caused by the explosion in the Merwehaven, could not occur here. A deep hole must also have been made in the bottom of the Merwehaven basin by which the forward movement of the caisson can also be explained.

Yet the caisson has been damaged here to a depth of 6 or 7 metres under low water. This was already suspected from the divers' reports, but certainty on this point was only obtained when a small part of the Waalhaven and 500 metres of the damaged quay wall had been drained behind the sand dam (as shown in Fig. 12). From an accurate examination on the spot it appeared that it was possible partly to repair the old construction perhaps in an altered form. This solution, however, was attended with as many technical and economical difficulties as other methods in which a quite new quay wall was built. Though very soon a definite choice will be made, the moment has not yet arrived to go further into the reconstruction of the quay walls in the Waalhaven basin.

It can be stated that the reconstruction of the quay walls in the Waalhaven which have been damaged over a length of 2,400 metres will take about 2 or 2½ years, provided there is no hitch in the supply of materials.

This is the concise story of the Port of Rotterdam up to to-day.

Though the harbour was heavily damaged by the Germans, yet two-thirds were left intact. The reconstruction of the damaged part has been put in hand under a three-year plan, so that the repairs will be completed by the end of 1948. Therefore, it is disappointing for Rotterdam that the Allies to such a large extent conduct the transport of goods to the hinterland of the Port of Rotterdam by way of German ports. This too, is the reason why, only two-thirds of the port's present capacity of 27,000,000 tons a year has been used during 1946.

May it soon be realised that transporting goods along the natural, and consequently most economical channels is not merely a local or a national interest, but is of great importance for the economic welfare of the whole world.

Continental North Sea Ports

Change of Present Traffic Routes Advocated

The division of traffic among the various Continental North Sea Ports has given rise to discussions of which notice has been taken by the press. The Economic and Social Council of the United Nations, the International Labour Office and UNRRA asked the European Central Inland Transport Organisation to study the question. The report printed below, which was sent by the Executive Board of ECITO to the Governments which are members of ECITO, is the result. The study is now being extended to the other Continental ports.

Introduction

1. The present scarcity of means of transport in Europe calls for the most economical use of available transport capacity. Conversely, it requires the avoidance of any waste, especially in the case of railway rolling stock, where the shortage is most acute.

2. An examination of the present situation of transport in Europe indicates that an important transport resource is not being fully exploited: namely, the Rhine and the lower Rhine ports.

3. The outstanding aspects of the present situation are, on the one hand, that the international rail system of Europe is being taxed beyond its capacity while, on the other hand, the capacity of the Rhine, normally a major artery for international traffic, is being used to only a fraction of its full potential.

4. A large section of western Europe lies within the natural hinterland of the Belgian and Netherlands lower Rhine ports, an area which roughly coincides with the Rhine drainage basin. The term " natural hinterland " here may be defined as that area which, for reasons of shortest distance, convenience and minimum haulage rates, normally finds it more expedient to ship through Rotterdam and Antwerp than any other salt water ports. At the present time, arbitrary restrictions have made it necessary for all that part of the natural hinterland lying within Germany to use North German ports at the expense of increased length of haul, reduced convenience to shippers, higher freight rates. Even more serious, overseas shipments to and from this area must necessarily utilise rail facilities, which might best be devoted to other uses.

5. There is little doubt that were a major portion of that traffic which is now moving by rail to and from the North German ports to be diverted to Rhine barges moving to and from the Netherlands and Belgian ports, several tens of thousands of railway wagons would be released for other essential services both within the zones and in international transit. Moreover, this re-diversion to the natural route would permit many thousands of tons of coal now being used in the shuttle service from the zones to the ports to be used for important industrial and domestic requirements.

6. It is outside the scope of the European Central Inland Transport Organisation to interfere directly or indirectly in the determination or administration of policy in the Zones of Occupation in Germany. However, in the light of the extreme scarcity of means of transport in Europe to-day, a scarcity felt as seriously by the zones as by the Allied countries, the Organisation takes this opportunity to draw attention to a phase of the situation in which, from a purely technical transport viewpoint, large economies could be effected. It should be emphasised that the Organisation is well aware that other considerations may make it impossible to utilise the suggestions embodied in this memorandum.

7. The study is divided into four parts. Part I deals with the pre-war situation; Part II summarises development since the outbreak of war up to the present time; Part III proceeds to appraise the situation in the light of the principle of transport economy, and Part IV proposes steps for improvement in the future.

Continental North Sea Ports—continued

8. Though the study is primarily concerned with technical considerations of economy of transport, reference has necessarily been made to such general economic considerations as affect the decisions taken and recommendations made with regard to the choice of means of transport and of routes.

Part I: Pre-War Situation

9. The relative position of the most important North Sea ports before the war can best be shown by the following table, which gives the amount of goods traffic handled by them in the years 1933-1936.

TABLE I.

Goods Traffic by Sea through various Ports (in million tons).

Year		Rotterdam	of which transit from and to Germany	Hamburg
		Antwerp		Bremen
1933	...	39.5	16.3	24.3
1934	...	44.7	21.8	26.4
1935	...	48.1	23.9	26.5
1936	...	54.7	27.8	26.8

10. The table discloses that a great deal of the sea-borne traffic through the Belgian and Netherlands ports was in transit to and from Germany. Despite certain steps, referred to below, to divert traffic as much as possible towards German North Sea ports, the proportion handled in transit to Germany steadily increased from 1933 to the war. The total transit, including that to Germany, accounted for about 40 per cent. of the traffic passing through Antwerp and for more than 75 per cent. of that passing through Rotterdam.

11. A consideration of the net tonnage of arrivals at the ports of Rotterdam, Antwerp and Hamburg gives the following interesting indications. Rotterdam and Antwerp each took approximately 8½ years to recover from the war of 1914-1918, while Hamburg took 10½ years. In 1938, the traffic through Rotterdam was 180% of that in 1920, that of Antwerp 170%, and that of Hamburg 140%.

12. The dominant position of the traffic routed through the Belgian and Netherlands ports is to be explained by the fact that it was carried mostly by inland waterways. In 1938, out of 27,214,000 tons of goods handled in Belgian ports, 13,421,000 tons (49.3 per cent.) arrived or left by inland waterways. Cargo movements on the Rhine and Maas to and from the Netherlands, where considerably more than 46 million tons were handled, amounted to about 35 million tons (76 per cent.). Almost the whole of the transit traffic through Rotterdam itself was moved by river craft. These figures show that the use of these ports was intimately linked with that of the Rhine shipping. The low freight rates on the Rhine, which were far below rail rates, made these ports most attractive, especially for coal and iron ore traffic to and from the Ruhr. This coal export and iron ore import through the Netherlands and Belgian ports amounted to 23,000,000 tons and 13,100,000 tons respectively. It corresponded to about 80 per cent. of the total coal and iron ore exported and imported from and to the Ruhr.

13. The improvement achieved in Rhine shipping before the war brought about an increase in the transit services of Belgian and Netherlands ports in yet another direction. The introduction of self-propelled barges resulted in more high-class goods being carried on the Rhine in the year immediately prior to the war than had ever been carried by water before. The great improvement in the navigability of the higher reaches of the river up to Switzerland had a beneficial effect upon the use of the Belgian and Netherlands ports; a considerable part of the 3,125,000 tons handled in 1937 in Basle and Rheinfelden passed through Antwerp or Rotterdam.

14. The strong and favourable position of the Belgian and Netherlands ports in transit traffic disclosed in the figures above was determined first of all by the cheapness and convenience of the inland waterways connecting these ports with the economically most important region in their hinterland, namely, the Rhine-Ruhr district.

15. In the presence of such natural advantages, it was difficult for the German North Sea ports to enter into competition with the Belgian and Netherlands ports for the bulk of the traffic to and from the Rhine-Ruhr region and South Germany. It was with the purpose of counter-balancing these natural advantages that deliberate German policies stepped in with special economic measures to attract the traffic towards German ports.

16. Attempts were made to this end in particular:—

(1) By the German railways offering very low rates for long distance transport to and from their port (Seehafenausnahmetarife);

(2) By the German railways demanding relatively high rates from transport to and from inland ports on the Rhine and its tributaries;

(3) By the "Kanalabgaben" which made it cheaper to ship goods from Dortmund to Emden than from Dortmund to the Rhine, though the former is a longer route;

(4) By the German tug monopoly on the waterways between the Rhine and Emden, which helped the latter by making preferential charges according to the direction of the traffic.

This policy was particularly effective where goods were routed through the Belgian and Netherlands ports and had to be transferred to rail or inland water transport, or vice versa. Owing, however, to the increased use of road transport, the adverse effect of (2) was only a partial one.

17. The German port which was best placed to compete with the Belgian and Netherlands ports was Emden. Its pre-war importance resulted, apart from the measures referred to above, largely from the construction of the Dortmund-Ems canal. Prior to 1900, the in-going traffic at Emden totalled about 80,000 tons a year, but with the opening of the Dortmund-Ems canal, the volume of traffic in this port, where special equipment for coal and iron ore transhipment was installed, increased to 2,800,000 tons in 1913 and in 1938 reached 6,280,000 tons.

18. When considering developments before the war, it should be borne in mind that there are also other factors which play their role when the choice of a sea-port for the routing of traffic is made. It is the availability of overseas shipping facilities and the preference given by consignors or consignees to ships of certain flags. In this respect, there was no particular difference between the Belgian and Netherlands and the German North Sea ports. It is noteworthy, however, that the German flag was predominant in Rotterdam (6,356 German out of a total of 24,744 ships called there in 1938); and that the Netherlands and Belgian shipping companies were regular customers of Hamburg and Bremen. Although port dues were reasonably low everywhere, shipping naturally preferred to use those ports where they were lowest; devaluation of currency temporarily attracted vessels to certain ports. Re-exports by sea with intermediate storage provided an additional asset for the Belgian, Netherlands and German ports, but this applied to all of them. The most important of these other factors in the choice of ports by sea-going vessels, namely, the prospect of obtaining return cargo without long delay, acted, however, in favour of the Belgian and Netherlands ports, as is shown by the figures given below.

TABLE II.

Sea-Borne Cargo, 1936 (in 1,000 tons).

Port		Imports	%	Exports	%	Total
Antwerp	...	11,873	50	11,706	50	23,579
Rotterdam	...	27,504	59	19,261	41	46,765
Amsterdam	...	3,485	62	2,170	38	5,655
Hamburg	...	18,241	68	7,501	32	25,742
Bremen (1937)		2,787	37	4,671	63	7,458

Part II.: Situation Since the Outbreak of War

19. The war has drastically affected the traffic through all North Sea ports. The efficiency of the Allied blockade prevented nearly all commercial activity. Matters changed for Antwerp and also later for the Netherlands ports during the period when they acted as terminals in the life-line of supplies for the advancing Allied Armies. The quantities of goods handled by the military authorities at Antwerp exceeded by far the peak pre-war figures.

Continental North Sea Ports—continued

(The comparison is, of course, not quite fair, because the military machine worked day and night.) After some months, however, this traffic dropped again, current movements required for the British and United States Forces in Germany being mainly directed to Bremen and Hamburg.

20. Apart from military traffic, there has been only a very slow expansion in traffic through all the above ports as the economic and industrial recovery of the countries concerned slowly developed.

21. The present situation is characterised by the fact that the transit traffic to and from Germany through Belgian and Netherlands ports has fallen to a very low level. Imports and exports by sea for Belgium and Netherlands themselves and other countries such as Switzerland, Luxemburg and Czechoslovakia cannot replace in importance the lack of German transit traffic.

22. The average monthly traffic to Belgian ports for the first four months in 1946 was 910,000 tons, or 37 per cent. of the monthly average for the year 1938. The corresponding figures for the Netherlands ports are 830,000 tons and 18 per cent. Of these quantities, 19 per cent. (160,000 tons) passed in transit through the Netherlands ports and 11 per cent. (102,000 tons) through the Belgian ports. So far as coal exported from the Ruhr for overseas shipment is concerned, 36 per cent. was programmed through the Belgian and Netherlands ports in September, 1946. In January, 1947*, this figure had risen to 47 per cent., amounting to 87,500 tons. The increase in traffic through these ports realised during the last few months does not enable existing facilities to be used to an economic extent.

23. So far as German North Sea ports are concerned, Hamburg is now largely used as inlet and outlet for the Ruhr district and for the regions south of it in the British Zone. Bremen is used largely for the U.S. Zone of occupation. Emden has handled, inter alia, a substantial amount of coal destined for onward conveyance by sea, especially for the Scandinavian countries. During September, 1946, for instance, the coal handled through Emden amounted to 64 per cent. of the coal exported from the Ruhr for overseas shipment. For January, 1947*, this figure was 49 per cent., amounting to 90,000 tons.

24. It appears that the Occupation Authorities tend to route imports and exports as far as they can through ports inside their zones. In doing so, they can carry out their programme independently and all dues and charges, labour and inland transport costs, can be paid by them in German marks without any currency problems arising.

25. The extended hinterland of German ports, however, throws an additional burden on inland lines of communication. Some of the traffic handled at Bremen is conveyed by rail to Hanau, which lies on the Main. Some 70,000 tons a month, mostly wheat, has recently been programmed for conveyance by rail and waterway from Bremen to Frankfurt, Mannheim and Munich.

26. Both Hamburg and Bremen resumed their respective pre-war positions as important sea ports for traffic to and from Czechoslovakia and other countries in Central Europe. It seems, however, that insufficient facilities are made available for this traffic, as some 40,000 tons a month of Czechoslovak foreign trade is now being routed through the Netherlands and Belgian ports via the Rhine.

27. It was shown in Part 1 how the natural and most economic flow of traffic through the Belgian and Netherlands ports was closely linked with the efficient and unhampered navigation throughout the whole Rhine system. The present situation, apart from the material influence of the war, is characterised by two factors.

28. On the one hand, there is no official rate of exchange for the mark, the practical effect of which, from the point of view of inland water transport, is that a part of the available means of transport is not used. Currency difficulties have another adverse effect on the use of the Rhine in connection with towage. The fact that Allied barges could not be towed by German tugs, and vice-versa, as there is no machinery for the payment of such services, has also been discussed by the Central Commission on the Navigation of the Rhine.

29. On the other hand, German Rhine shipping is not allowed access to Belgian and Netherlands territory, with the result that the Occupation Authorities, in order to get consignments to or from their zones to the Belgian and Netherlands ports, are compelled to use non-German shipping and to pay all expenses incurred in foreign currency. As they are reluctant to do this, the consequence has been that barge capacity on the Rhine is far from being fully used, and the rates have gone up, as the bargees have to make their living out of the little work which remains to be done.

Part III: Assessment of the Situation Before and After The War

30. From the description of the position before and after the war, and especially from paragraph 18, it will be seen that the routing of traffic from and to North Sea ports is dependent in the first place on the expenditure incurred on movement over inland lines of communication. Port facilities being substantially the same for all ports, the selection of the port is based, apart from the influence of sea freight rates, on convenience together with the cheapness of the inland lines of communication. In consequence, the route involving the smallest transport effort should be used, in order to avoid a waste of transport capacity.

31. With this principle of transport economy in mind, it seems possible to determine the respective natural spheres to be served by the several North Sea ports. It is reasonable to assume that the general demarcation line separating the spheres of the Belgian and Netherlands ports from those having the German North Sea ports as their appropriate outlet runs from Cheb, the most westerly point of Czechoslovakia, to Hamm in Westphalia, the most easterly point of the Ruhr region. The demarcation line in the South, namely as against the Mediterranean ports, is not so simple to define. This aspect of the question is, however, outside the scope of this study; as is also the division between the Belgian, Netherlands and French ports and between the North Sea and Baltic ports.

32. The natural hinterland of the Netherlands and Belgian ports appears to be the basin of the Rhine and the Scheldt with their tributaries and adjacent canals, Southern Germany, Western Austria and part of Switzerland, whereas the German North Sea ports find a natural hinterland in most of the rest of Germany, and in part of Austria and of Switzerland and Czechoslovakia.

33. It is of interest to see how far the routing of the actual traffic through North Sea ports respected in the past, and is now respecting, the demarcation lines established above.

34. For the past, it can be said that there was no tendency for the Belgian and Netherlands ports to extend their natural hinterland at the expense of the German North Sea ports. Transit traffic to and from the region East of the Hamm-Cheb line was only handled exceptionally by these ports. It consisted mainly of urgent consignments of high value goods for shipment to America and imported raw materials which had to be processed in specialised Belgian plants (e.g., de-greasing and washing of wool).

35. The same cannot be said of the German North Sea ports; the efforts of an artificial character designed to attract traffic from outside their natural spheres have already been described in Part 1. It is difficult to assess the benefit derived by Bremen and Hamburg from this policy, but as far as Emden is concerned, this port took 15 per cent. of the ore and coal traffic to and from the Ruhr.

36. Nevertheless, on the whole, it may be said that the pre-war flow of traffic to and from the North Sea ports corresponded very nearly to the division of the respective spheres of activities of these ports and thus ensured the most economic use of inland lines of communication.

37. It is important to ascertain that this, on the whole, satisfactory situation was achieved before the war in spite of a relative abundance of transport capacity which could have justified a more liberal departure from strict considerations of transport economy. The routing of traffic as it had established itself up to the war

* 30th December, 1946, to 26th January, 1947.

Continental North Sea Ports—continued

could therefore serve as a desirable model for any development in the future to attain an economic and well co-ordinated output of the transport systems in this sector.

38. In the present situation, characterised by a substantial decrease of efficiency of European transport systems resulting from the war, this consideration of transport economy has grown in importance, and is, in fact, imperative.

39. If the present situation is assessed, it appears from what was said in Part II that Germany has now been arbitrarily removed from the natural hinterland of the Belgian and Netherlands ports. The traffic goes mostly by rail through Bremen for the U.S. Zone, although this is a longer route, and for the British Zone through Emden and Hamburg.

40. Out of the total movement programmes of the U.S. and British Zones in Germany, it appears that consignments of a magnitude of about 300,000 to 400,000 tons are to be handled monthly by Emden, Hamburg and Bremen, which, considering the longer inland lines of communication thus involved, could be routed more advantageously through the Belgian and Netherlands ports as before the war. This applies particularly to the traffic to and from the Frankfurt-Munich region.

41. The present routing practice results in a strain on rolling stock and on river craft, especially tugs, which is bound to be felt more acutely as the gradual recovery of German industry increases the volume of transport. There are, therefore, certain limitations to the present routing policy, such as the capacity of ports and of their inland lines of communication and the availability of rolling stock.

42. In the special case of Emden, the share in coal exports from the Ruhr compared with the share of the Belgian and Netherlands ports is now almost the reverse of what it was before the war. It is felt that a return to pre-war proportions would be in the interest of the economy of transport. (See also paragraphs 17, 22 and 23.)

43. In one respect, the Belgian and Netherlands ports are at present handling some of the traffic that before the war was usually carried through the German North Sea ports, in particular Czechoslovak overseas transport referred to in paragraph 26. If German transit traffic were to be divided among North Sea ports on a rational basis as before the war, there would be no technical reason why most of the Czechoslovak trans-Atlantic trade should not return to this route, the use of the Belgian and Netherlands ports being confined, for this traffic, to roughly the same scale as before the war (see paragraph 34).

Part IV: Recommendations

44. After careful assessment of all the factors involved, the European Central Inland Transport Organisation advocated as early as at the Copenhagen Conference (3rd to 6th June, 1946) the return of an appropriate part of the German traffic then routed through German North Sea ports to the natural route along the Rhine through the Belgian and Netherlands ports. The Conference, after discussing this matter, unanimously recommended that no measures should be taken to direct trade into and from Central Europe through German seaports, in so far as such measures were not consistent with sound economic principles and that, therefore, all discrimination against Western European and Baltic Allied seaports should be avoided.

45. It is not for the Organisation to interfere in the political and economic agreements between various countries in, for example, the precautions which the Governments concerned might wish to take against a possible future return of the dominance of German shipping—but it seems, from the purely technical standpoint of transport, to be eminently desirable that the resolutions of the Copenhagen Conference should be implemented as soon as possible.

46. It must be emphasised that substantial economies in means of transport would ensue:—

(a) if the zones were to carry their traffic on the normal pre-war routes; and

(b) if all facilities to Rhine shipping, including towage, port facilities, repairs, supplies, etc., were restored throughout the Rhine system on the same terms as existed before the war, payments of eventual balances to be made through a clearing house or other similar arrangement.

47. With regard to (a), it might be asked whether there is enough Rhine shipping available. The answer is in the affirmative. The 50 per cent. or so which remains of the pre-war Rhine fleet would be ample if properly organised and allowed to ply freely on this international river. It will be remembered that before the war the Rhine fleet was larger than was necessary even for peak traffic periods.

48. Regarding (b), it is suggested that the movement of traffic throughout the Rhine system be improved by the abolition of all present restrictions and discriminations, and by the establishment of a clearing house for mutual services rendered. This house would eliminate in a practical way all difficulties of a financial nature, which are now hampering the full use of existing technical facilities and possibilities. The transport capacity of the Rhine and adjacent waterways could be greatly increased by some such arrangement.

49. If the consignments suitable for routing through the Belgian and Netherlands ports were transported on the Rhine, two important results would follow:—

(a) The greater volume of goods to be carried would bring down the freight rates on the river. Lower rates would in turn make the route more attractive.

(b) A considerable amount of rolling-stock would be set free, thus easing a rather serious position on the railways which is now developing. Assuming that only 10,000 tons a day could be carried via the Rhine to the Belgian and Netherlands ports instead of by rail to Emden, Bremen and Hamburg, respectively, and assuming a turn round of 7 days for a rail wagon carrying an average of 10 tons, about 7,000 wagons would be released. Shorter hauls to, and quicker transhipment in, the Low Countries would save another 1,000 wagons.

50. The European Central Inland Transport Organisation is, of course, fully aware of the financial implications of the above recommendations, particularly for Germany. It is difficult for the Organisation to estimate the disbursements in non-German currency which the occupation authorities might have to make if traffic were to be allowed to follow its natural course. At the same time, it would appear that the sums involved would not be very considerable, and that they would be at least in part offset by economies in rolling stock and in coal used for rail transport to German ports. The coal thus saved might be exported for non-German currency or used for purposes assisting the recovery of the German exports.

Port Working Equipment at Rotterdam

The following tables show the present equipment of the port compared with May, 1940:

	Quay Cranes	Floating Cranes	Loading Bridges	Floating Elevators	Tugs
May, 1940 ...	282	80	28	26	250
March, 1947 ...	160	62	2	28	135

Of the 160 quay cranes, 153 are of light type and only 7 are of heavier type, 10-20 tons. Of the 62 floating cranes, 42 are light and 20 are heavier, 10-15 tons.

Storage Facilities
(figures in thousands).

	For general cargo, sq. m.	Grain silos, tons	For petroleum, tons	For edible oils, tons
May, 1940 ...	700	125	900	270
March, 1947 ...	360	125	730	210

PORT OPERATION

Part 3 (B) of a series of articles by A. H. J. BOWN, M.Inst.T., A.C.I.S.
and Lt.-Col. C. A. DOVE, M.B.E., M.Inst.T.

(Continued from page 15).

Aerial view of Kidderpore Docks, showing (1) straight line layout of quays; (2) Entrance Dock; (3) Turning Basin; (4) Dry-Docks (with ships), leading into Turning Basin; (5) Vehicular Bridge between Nos. 1 and 2 Docks in open position; (6) Ships at Lock Buoys; (7) Nos. 27 and 29 Berths; (8) Ramped Cargo Berth at extreme left of Lock with L.S.T.'s berthed; (9) Railway Sidings leading to Docks.

Design and Layout (continued)

Influences in Design

The size and shape of a dock are affected and determined by many factors, including the age and historical development of the port in which the dock is situated; the size, shape and value of the available land; the natural depth of water; the requirements of trade, including the dimensions of ships likely to use the port; the amount of excavation necessary and the possibility or desirability of increasing the depth of water in the dock by pumping in additional water.

Requirements in Design

A wet dock should be wide enough (1) to allow ships to be safely navigated within the dock, including turning them without taking them out into a turning basin or approach channel for this purpose; and (2) to permit of moorings being laid, if they are required.

Use of Moorings in Docks

Moorings are laid in docks for a variety of reasons, including (1) vessels under repair or awaiting dry docking. Such vessels, by reason of the repairs they require, are sometimes not sufficiently sea worthy for mooring in tidal waters and are accordingly brought into the calmer waters of the dock, either whilst the repairs are being carried out or to await their turn for dry dock; (2) vessels waiting for loading or discharging berths to become vacant. Considerable improvement in ships turn round in enclosed docks may sometimes be brought about by laying moorings near to working berths, to which ships can be tied up whilst waiting their turn to come alongside the berths when they become vacant. In this way the loss of time which arises during busy periods, when ships have to wait outside the dock until berths become vacant, is avoided. Newport is a good example of a dock in which ample mooring accommodation has been provided for ships. In the busy days of coal loading, it was a common sight to see two lines of ships lying at the moorings in the docks, waiting for coal loading berths to become available; (3) working overside cargo only, e.g., salt and jute at Calcutta. (In general, however, complete overside cargoes are dealt with outside enclosed dock waters, where possible, to avoid unnecessary movements of the ship and the payment of dock dues and dock pilot's charges). (4) bringing vessels into calm water for reasons of safety, even though they do not require alongside berths, as is the case during the "bores" at Calcutta. (5) bunkering whilst waiting for a berth. (6) lying up. In general, ships should not be laid up in dock waters unless other accommodation is not available.

Design of Quays

Berths, whether they form parts of open quays or are situated in docks, are constructed either in a continuous straight line or on the jetty principle. In a port where there is a good depth of water but a restricted length of water front and a limited width of land, the number of berths can only be increased by building jetties out into the water. Alexandria, one of the oldest ports in the world, provides a good example of a port originally constructed on the straight line principle, at which jetties have since been provided to meet the demands of ships for deeper water. The port is contained on a narrow strip of land, hemmed in, except at the western end, by heavily built up areas, so that increasing the size of the port by excavating another dock—even if it were an economic proposition—was not possible, nor could depths at the berths be increased sufficiently by dredging owing to the construction of the quay walls. A good depth of water is available, however, at no great distance from the quay walls. In addition, the bed of the harbour lends itself to dredging. As a result, jetties have been built out into the harbour at the eastern and western ends and in the centre, providing, in some cases, depths varying from 29 to 35 feet alongside. Even at the old berths, deep water can be provided by breasting ships off with 20 feet wide pontoons, which can be used as extensions of the quay for cargo handling purposes. The drawback to this arrange-

Port Operation—continued

ment is that it prevents, for all practical purposes, direct delivery to land conveyance and the use of quay cranes for loading or discharging.

In a port where there is a restricted water front, but plenty of land available for excavating docks, either open or enclosed, then the form of the dock depends on the shape of the land. If the land takes the form of a narrow strip, then jetties are not possible; if, on the other hand, it is wide, then the choice rests with the designers, whose aim is to provide the maximum number of berths of the requisite depths for ships likely to use the port.

The following examples serve to illustrate the differences in design which are to be found.

In Liverpool practically all the berths in the enclosed docks are built on the jetty principle, as will be seen from the aerial view below. The passenger landing stage, which is not enclosed, however, is built so that vessels are berthed parallel with the flow of the river.

Photo by courtesy of the Mersey Docks and Harbour Board.
The Alexandra Docks and Branch Docks designed on jetty principle. Overhead gallery (left background).

At Calcutta, on the other hand, both the enclosed docks and the open riverside wharves operated by the Commissioners are constructed on the continuous straight line principle. (It is to be noted that the two main open wharves are known as Calcutta Jetties and Garden Reach Jetties. This use of the word " jetties " is apt to mislead U.K. students into thinking that these wharves are constructed athwart the flow of the Hooghly, which is not so. The word " jetty " has come to be used as a time honoured custom, apparently because Calcutta jetties, which date from 1869, were originally constructed in the form of jetties).

Both designs are to be found in the enclosed docks of the Port of London. At Tilbury Dock the jetty principle is to be found, but in the Royal Docks system the continuous straight line design is followed. (Within recent years the north side of Royal Victoria Dock, which is the oldest dock in this system, has been converted from jetties).

Many tidal waters, such as the Thames, Hooghly (Calcutta) and Rangoon River, carry heavy deposits of sand and mud. It has been found in such waters that jetties projecting out into the stream are likely to cause silting, or even a diversion of the channel. In consequence, open quays and wharves are usually built flush or parallel with the banks on these and similar rivers.

In restricted and tidal waters, jetties are frequently designed at an acute angle to the mainland, to provide more manœuvring space for ships and to minimise the difficulties caused by having to navigate them athwart the stream when turning to come alongside or on leaving the berths, as is frequently the case when jetties are built out at right angles. This design has the further advantage of providing easier curves for locomotives and railway wagons to negotiate. Cases have arisen where jetties could not be rail served owing to the impossibility of laying a curve which could be used by locomotives and wagons with safety.

The depth of water (1) in the case of open quays or docks should never be less than approximately one foot deeper than the deepest draughted vessel likely to use the port (the minimum amount of water required under a vessel depends on local conditions and is decided by the official responsible for navigating the ship, e.g., master, pilot, harbour master or berthing master); (2) in the case of enclosed docks, not less than the maximum depth attained over the entrance sill (this depth could be maintained either by pumping or dredging, or both).

At an ordinary cargo-ship berth, the quay surface should be about 6 feet above the high water level at spring tides (H.W.O.S.T.). In enclosed docks, a good margin should be allowed to permit of pumping in additional water if necessary. It is interesting to note that the level of water in Kidderpore Docks, Calcutta, is kept, by pumping, to a height of 5 feet above the level which was originally intended when the dock was first opened in 1892.

Once the general shape of the dock has been decided, the question of the layout of quays arises. The length of berths should be related to the size of the vessels using the port. Vessels range in size from the small sailing vessel, whose length may be measured in tens of feet, to the ocean going liner, measuring nearly a quarter of a mile in length. For this reason it is difficult to generalise, but for general cargo purposes 450-500 feet would seem to be a good average length for a ship's berth. It is interesting to note that during the war a length of between 440 feet and 460 feet was decided on as the overall length for the liberty type ships, which were built in considerable numbers.

Quays used for berthing ships should be fitted with rubbing bands and equipped with bollards. Where it is not possible to place bollards right on the quay edge, they should be set six to twelve inches back, so as not to come into contact with and damage ships' plates or interfere with the moving of quay cranes. It is also found at this distance that they are less likely to foul the " pitch " and impede landing and loading operations. (Pitches are the areas on the quay on which sets are made up or landed.) When bollards are placed right on the quay edge, they are set with a slight cant towards the quay and designed so that they present a smooth surface only to the ship's side, with all protuberances in the form of horns and lips pointing away from the ship. (All quay bollards are fitted with horns or lips to prevent the eyes of the mooring ropes slipping off them.) They should be spaced about 50 feet apart for the full length of the berth or berths. This continuous spacing allows for variations in the lengths of ships and enables them, once they have been berthed, to be moved ahead or astern as required.

It is frequently necessary on berths used by large ships to fit two additional bollards, one at each end of the berth, well back from the quay edge, for head ropes and breast ropes. Such bollards should be situated well clear of quay cranes and rail tracks. It is obvious, of course, that occasions will arise when ropes made fast to these bollards will have to be taken in and put out again to allow quay cranes to be moved and rail wagons to be shunted.

Modern quays should be laid out to accommodate both rail and road traffic and designed so that ships' derricks at all hatches can plumb with their maximum loads at least one line of wagons for direct delivery. It is not sufficient for rail tracks to be so positioned that direct delivery can take place only with the use of quay cranes, for the essence of fast working lies in being able to put every available hook into the ship, or increase the number of purchases at any hatch, when required. It is also important that discharging and loading should be independent of crane breakdowns and power failures. In effect, this means that the number one rail track should be placed as near as possible to the quay edge. (Railway tracks are normally numbered from the quay edge, the track nearest the quay edge being known as

Port Operation—continued

number one, the next one number two, and so on. For convenience, tracks on the water side of the transit shed are known as " quay lines " and those at the rear of the transit shed as " platform lines.") Where the quay is equipped with portal or gantry quay cranes, the number one track runs under the quay cranes, which are mounted on legs.

The actual positioning of the number one track depends on (1) the strength of the quay; and (2) where the quay is equipped with quay cranes, the position and clearance of the crane's legs. Apart from the question of strength of quay in relation to the weight of quay cranes and railway engines, it is important that every operating man should know the maximum weight which may be put on each square yard of quay and the minimum distance from the quay edge at which this weight operates.

It is very important to remember in laying out quays that structures and equipment should be designed to cause the least possible obstruction to the free movement of cargo, the minimum of fatigue to labourers, and the least possible wear and tear to transport. For these reasons, crane and rail tracks should be laid flush with the quay surfaces, i.e., the tracks should be sunk and the ballast covered to rail level throughout the port area, wherever dock labour or road transport is likely to operate over them.

Quay surfaces are also very important and need to be considered in relation to (1) durability, and (2) their effect on labour and transport. It may be said that wooden surfaces are least satisfactory for general cargo or rough work, because of their lack of durability, their relative resistance to hand trucks and their liability to splinter, which is a particular menace to labour in hot countries where workmen do not always use footwear. These disadvantages are not so important at berths used only for passenger traffic, where the packages are not heavy nor the work rough on quay surfaces. Wooden surfaces are also more susceptible to damage by fire. Stone or granite sets are very durable, but tend to cause more fatigue to labourers and are harder on transport. They also require frequent resetting to correct uneven surfaces. Tarmac and similar surfaces are satisfactory when rapid construction is important, but wear easily and cut up with rough usage, particularly in hot climates. Concrete appears to be the best surface for general working purposes. It provides a good, hard wearing surface, which is less fatiguing to labour and comparatively easy on transport.

The layout of a berth in respect of railway lines and transit sheds depends upon the type of cargo it is intended to handle. A general cargo berth should be road and rail served alongside the front of the quay. (The front of the quay i.e. the area between the quay edge and the transit shed or area is sometimes known as the " apron.") The number of quay rail tracks depends on the space available, but in general there should not be less than two and rarely more than five. Where a number of berths finish at a dead end, one line should act as a release road for the engines bringing on the wagons. The tracks should be arranged so that each berth can be shunted independently of its neighbour, and, for this reason, there should be at least one set of crossovers (turnouts) between each set of rails on each berth. This is very important where a number of berths are laid out in the same straight line.

Berths are equipped with capstans to ensure the accurate placing and shunting of wagons. Capstans are not in universal use and, where they are not employed, mechanical shunters capable of pulling and pushing wagons have been introduced. In those ports where neither method is practiced, hand shunting is resorted to, but it is slow and requires much more shunting engine power and time to set up and clear the quays.

Transit Sheds

General cargo berths are provided with transit sheds. The purpose of a transit shed is to provide temporary accommodation for (a) goods discharged from vessels awaiting clearance through Customs and/or conveyance to destination or warehouse; (b) goods waiting to be loaded to a nominated steamer. In no sense should transit sheds be regarded or used as warehouses.

The transit shed should be situated in the centre of the berth. The size of the transit shed depends on the size of the berth it serves and the area and the shape of the land on which it is built. A good average size for general ocean going cargo ships is 400 to 500 feet long and 100 feet wide. Broadly speaking, a shed for general cargo should be large enough to accommodate at least three days' discharge or, in the case of exports, at least one third of the cargo to be shipped. This arrangement should prevent delays to discharging, because of transit shed congestion, and to loading, because of lack of cargo. This is a matter which will be dealt with in greater detail in a later chapter. In assessing the space required, allowance must be made for stacking cargo so that clear alley-ways are left between all doorways facing each other, and all consignments are easily accessible and recognisable. In addition, high piling, particularly of heterogeneous cargoes, is to be avoided when possible. Cargo in transit sheds must be kept on the move, and this salient characteristic must be kept uppermost in the mind when designing and deciding dimensions.

It should have plenty of wide doors, not less than one to each hatch of the vessel being worked, more if possible, both at the front (facing the quay edge) and the back (abutting on to the platform lines) and two at each end. The doors at the front and back should be constructed directly opposite each other, thereby providing direct and uninterrupted access from the ship's side right through the transit shed to the loading banks and platform lines at the rear of the shed, and vice versa. Doors should be wide enough and lofty enough to allow the passage of motor transport and of mobile cranes carrying a load, i.e., with their jibs in the up position. In order to take up the minimum of space and to provide the least possible obstruction to the movement of cargo, they should not be hung on hinges fixed to the lintels of the doorways, but should either be sliding or made on the roll-up shutter principle. Sliding doors should be suspended from overhead rollers in preference to running on tracks set in the ground, for it is found in practise that not only do such tracks increase the fatigue to truckmen and the wear and tear on tyres, but they tend to become clogged with foreign matter, and thereby impede the movement of the doors. Tracks are also liable to be damaged by the passage of vehicles over them, and, when this happens, difficulty is experienced in closing the doors. All transit shed doors should be fitted with good locks.

To prevent damage to the lintels of transit shed doorways by runabouts, mobile cranes, motor transport, etc., it is usual for concrete or stone posts (sometimes short lengths of rail are used) to be set in front of doorway lintels in such positions that they take the impact of any collision which may occur.

The interior of the transit shed should be designed with a minimum of stanchions.

Lighting should be as high as possible. Reflectors or modern fluorescent lighting should be used. In single storied transit sheds, plenty of skylights should be provided.

A " lock up " (" cage " or " compound ") should be constructed inside the shed for the housing of highly pilferable or frail cargo. In addition, there should be a Customs lock-up, where highly dutiable cargo can be examined by Customs officials and temporarily housed in transit when necessary, pending payment of duty. All lock-ups and cages should be fenced with very high but open fences, so that shedmen, policemen and watchers can see inside them, even when they are locked. The interstices in the fencing should be sufficiently narrow to prevent pilferage from outside the cage.

In Calcutta some of the transit sheds have been fitted with a self-contained annexe at one end for the accommodation of " dirty cargo," e.g., paint, oil and ghee. These annexes make possible the segregation of dirty cargo from the other cargo, and thereby limit the possibilities of contamination. In addition, they have the effect of localising the extra cleaning which follows the accommodation of dirty cargo.

A certain amount of accommodation has to be provided for quay staff and sometimes for Customs officials. This is usually provided in the form of moveable huts placed in the transit shed. In some transit sheds, offices are built above lock-ups. This

Port Operation—*continued*

arrangement effects an economy in floor space and provides an additional measure of security for the cargo in the lock-up. It would not usually be practicable in cases where it is necessary to use mobile cranes in the lock-up, because of the lack of sufficient headroom.

Some transit shed floors are built above quay level to the height of railway wagon or lorry floors. This design, which has the effect of surrounding the shed with a platform, is not suitable on berths where cargo is worked direct to or from ship's side to shed by hand, hand truck or mechanical runabout. The advantages of being able to truck straight into or from the shed without lifting or lowering the cargo are so obvious, however, that the ground floors of transit sheds are generally built on the same level as the quay. Many floors, however, are sloped upwards from quay level to wagon floor height at the rear; in this way a loading bank is provided at the rear of the shed for railway wagons and at the ends for motor transport. This slope facilitates washing down and cleaning.

Loading banks should be protected by overhead verandahs or lean-to's made sufficiently wide to enable delivery or striking gangs to work in all weathers. Sometimes the same effect is produced by building the first floor and above wider than the ground floor. The student must remember that in the U.K. and in monsoon countries many ship loading and discharging hours are lost because of bad weather, and it is therefore necessary to eliminate the possibility of stoppage to the work from this cause wherever possible.

Modern practice is to build transit sheds two stories high. Double storied transit sheds are constructed (a) where the shed is near enough to the quay edge for ships' gear to discharge to or receive direct from the first floor of the transit sheds; or (b) where the quay is equipped with quay cranes which can plumb the first floor. These floors are fitted with verandahs wide enough to enable shore gangs to make up or receive cargo sets on them. Sometimes these verandahs are fixed structures running the full length of the shed and sometimes they take the form of hinged platforms which may be taken up flush with the shed walls when not in use.

An important advantage of double decker transit sheds is that, by spreading the work over two floors, they relieve congestion at the ship's side by reducing the number of "pitches" at quay level and consequently the number of labourers and runabouts, without slowing down the rate of ship work. This thinning out on the quay is a great help in speeding up the work, particularly when all cargo is being discharged to or loaded from shore, and some hatches are working direct to or from land conveyance. (A "pitch" is the area at the ship's side on which the set (also known as the "draft") is landed when it is discharged from the ship or on which it is made up ready for hoisting into the hold of the ship, e.g., a ship discharging five hooks to shore,

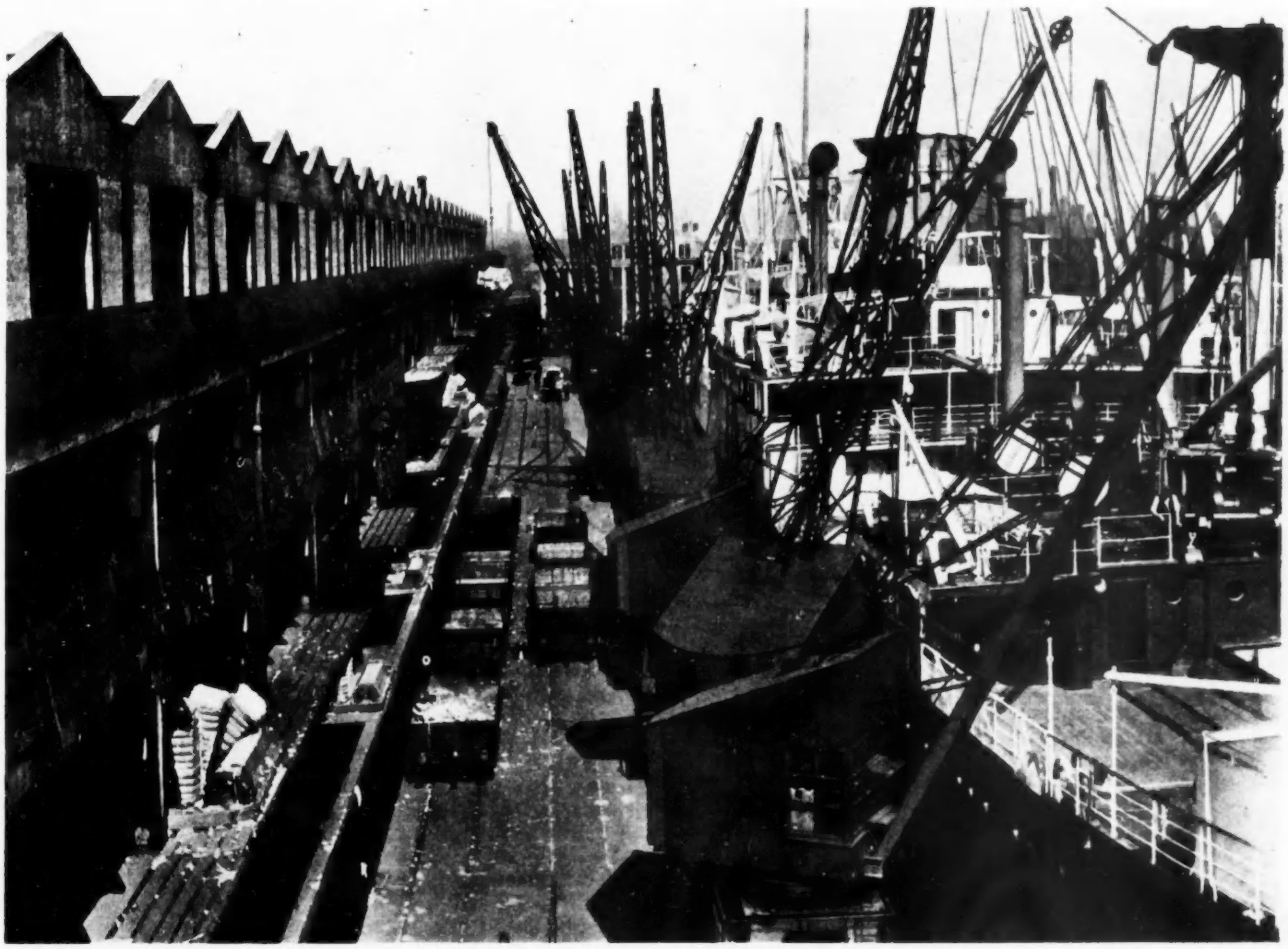
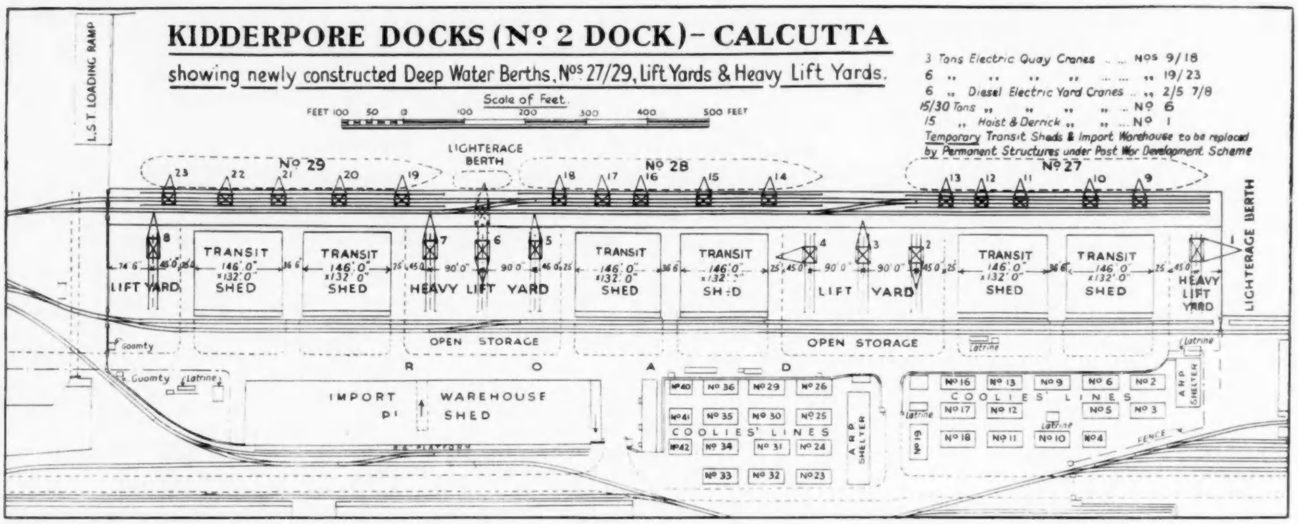


Photo by courtesy of the Manchester Ship Canal Company.

Cotton being discharged direct to 5 storied transit shed by quay crane, showing (1) fixed verandah on first and fourth floors; (2) hinged platforms on second and third floors; (3) quay lines (two sets) with crossover; (4) capstans for hauling railway wagons; (5) ships gear rigged for dragging bales into square of hatch.

Port Operation—continued



would use five pitches.) Double storied transit sheds require "delivery" cranes or hoists at the rear and ends for delivering to or from the first floor as well as lifts. Where the quay in front of the shed is fitted with quay cranes, they can be used for making delivery to or from the first floor at the front (water side) of the shed when they are not being used for ship's work.

It is not unusual for transit sheds to be built more than two stories high—in Manchester some go to five stories—but in such cases the floors above first floor level are often treated as warehouse accommodation. In America such sheds are frequently built nine stories high.

Transit sheds should be rail served at the rear. In general, there should be one loading line next to the shed; then, dependent on the space available and the type of cargo being handled, there should be one or two standing lines for wagons waiting to be loaded or struck. Where quays are constructed in a continuous straight line and not on the jetty principle, a through running line would be laid next to the standing lines. Where several berths are constructed together, it is a great advantage, if space permits, to lay additional tracks on which preliminary sorting and marshalling can be carried out before the wagons are drawn off to the main sorting sidings. All the lines should be connected by cross-overs. Each group of quays should be provided with an end-on ramp for the purpose of driving vehicles, farm tractors, etc., off or on to flat railway wagons, to or from road level.

The roadway for vehicle traffic is normally situated next to the railway lines. In the case of berths constructed in the same straight line, this would be the through dock road; in the case of berths constructed on the jetty principle, it would, of course, lead off from the through road and run between two lines of transit sheds. Both types of roadways should be as wide as possible, and the through road should be wide enough, at least, to allow for a two-way stream of traffic and for lorries to be parked on each side of the road whilst waiting their turn to be loaded or struck.

The distance between the ends of neighbouring transit sheds should be great enough to allow the free movement of transport, mobile cranes, runabouts, etc., to and from the berths. In calculating the size of the area required, due allowance must be made for the space required for lorries backing up against the end loading ramps to receive or strike cargo. Where space permits, this area also makes a suitable site for a lavatory and a drinking water tap (an extremely important installation in hot countries). Where drinking taps are provided, they should be fitted with press spring buttons to prevent taps being left running. This happens very frequently in hot countries, where the labourers drink enormous quantities of water during the day. Apart from the wastage, water allowed to run over quays can cause considerable damage to some cargoes, particularly those contained in bags. This area also provides a suitable central parking space for a mobile canteen where one is used.

Where space permits, such areas can be designed as heavy lift yards and the quay fronts between the berths used for lighterage. Such lighterage berths, which are really a continuation of the ships' berths on each side of them, are particularly useful for handling heavy lifts and overside cargo. One, or if the volume of work justifies it, two travelling portal cranes, capable of lifting up to, say, 25 tons at their maximum outreach, should be provided in these lift yards, with their tracks set at right angles to the quay wall, so that they can work direct between lighters and road or rail conveyances in the heavy lift yard, if required. Properly planned such yards do not interfere with the movement of traffic to and from the ships' berths or the transit shed. At the same time, they keep the ships' berths clear of much of the slow work connected with heavy or awkward lifts, which would cause congestion and delay if dealt with at the ship's side.

Lighting

The aim of all dock lighting is to provide a good general diffusion of light which causes a minimum of shadows to be cast and creates the least possible variation between the bright and dark places where work is proceeding.

Quay lighting should be provided by means of wall lights fixed to transit sheds and lofty standards. Reflectors or modern fluorescent lighting should be used. Wherever practicable, wiring should be laid underground to avoid damage caused by crane jibs and bad weather. In general, quay lighting is rarely good enough for checking or tallying at night. For close work of this nature, each checker should be provided with a self-contained unit lamp. Electric torches, which the checker can fasten to his coat, are useful for this purpose. Crane lights add to the lighting provided. Apart from the lighting in the crane cabins, it is usual to have one light on the jib head, which is fixed so as to shine directly on the set being hoisted or lowered, and a strong light fixed on the outside of the cabin with its beam directed towards the crane chain. Opinions differ among crane drivers as to the value of this light, owing to the fact that the set passes through its rays. Ships generally provide their own lighting, although it is quite common for arrangements to be made by port undertakings for ships to obtain auxiliary lighting by plugging-in ashore; the objection to this method is that the electric wires are always likely to be carried away by the passage of cargo sets to or from the ship.

Quay Hydrants

Ship watering hydrants for supplying fresh water to vessels alongside berths should be placed as near to the quay edge as

Port Operation—*continued*

possible, on the quay wall face for preference, but in such a position that the meter can be easily read. This position does away with the necessity for laying ship watering hose across the quay, thereby eliminating the possibility of damage to the hose by lorries, runabouts, hand-trucks, mobile cranes, etc., and the damage to cargo caused by leaky hoses and bad connections flooding the quay. Where hydrants are so placed that hoses must be stretched across the quay, then ramped covers should be used for their protection, although in practice they are found to be far from satisfactory.

Open Transit Areas

Some berths are not equipped with a transit shed, but are provided instead with a large open transit area, which serves a similar purpose. This arrangement is more suitable for certain cargoes, such as bulk ore, scrap iron and coal. Timber is another commodity which is frequently discharged to an open quay, not only because of the large area it takes up, but also because of the considerable sorting which is sometimes necessary before it can be delivered. It is not unusual for complete cargoes of timber to be discharged, sorted and piled before delivery takes place. Timber is sometimes discharged to covered open storage, i.e., an area protected by roofs, which are supported by uprights but not walls (see picture on page 305, April 1947 issue). Apart from the absence of transit sheds, the layout principles for these open berths are the same as already described.

Ancilliary Buildings-Siting

On the other side of the through roadway, i.e., the side farthest removed from the transit shed, are usually to be found warehouses, gear stores, hydraulic power stations, paint stores, general stores, offices (port undertaking, Customs main office, shipping companies, agents, stevedores, master porters, etc.), engineers' stores, maintenance shops, garages for transport, mobile equipment and appliances, medical rooms, police station, fire station and other buildings, even including shops in some docks.

Warehouses

Warehouses, which may run to six or more stories, in addition to cellars or vaults, are frequently connected to transit sheds, which are more than one storey high, by overhead covered-in galleries. The advantage of these galleries is that they allow the transference of cargo from transit shed to warehouse in all weathers, ensure a relatively short haul, and, by keeping this traffic off the ordinary dock roads, assist in reducing the possibility of congestion. The method of transporting cargoes across these galleries depends on the type of cargo and, of course, the age of the installation. In modern warehouses, mechanically operated runway is used to transfer suitable types of cargo such as frozen meat and bagged cargoes; it is not unusual, however, for cargo to be trucked across these galleries.

Warehouses should be weather proof, vermin proof, well lighted and adequately ventilated, according to the type of cargo being stored. They should be road and rail served at the back and front and road served at the ends. As in the case of transit sheds, railway tracks should be sunk so that the tops of the rails are flush with the road level. Some warehouses are constructed with the ground floor at road level, and others with the ground floor at tail board level, in which case they are surrounded by a loading bank.

Deliveries are made, or cargo is received, on each floor through delivery hatches, which are really wide doorways cut in the walls of the warehouse, fitted with doors which are governed by the same broad principles as transit shed doors. Where fixed verandahs are not used, each delivery hatch is fitted with a flap which can be let out to form a platform when cargo is being received or delivered.

Warehouses should be equipped on each side with wall cranes or travelling roof cranes. The wall crane is a static installation which is fixed in such a position that it can plumb a hatchway on each side of it on the top floor and all the hatchways immediately below these. The travelling roof crane is much more costly to install, not only because it is in itself a more expensive piece of equipment, but also because of the extra strengthening which is required to the warehouse to support it. It possesses, however, the valuable asset of mobility, which means it can be put to much greater use than the fixed wall crane.

All floors should be connected by lifts or hoists, as well as stairs.

The interiors of the warehouses should be constructed with as few stanchions or supports as possible. Floor surfaces are important, and, although they are not subjected to the same rough treatment as transit shed floors, the same considerations affect the choice of substance to be used.

Lighting is an important factor and the same broad principles already mentioned should be followed. Modern fluorescent lighting or cluster lights with reflectors should be used, with plenty of window space. Walls and ceilings should be treated with a light coloured wash or paint. The top floor should be fitted with skylights..

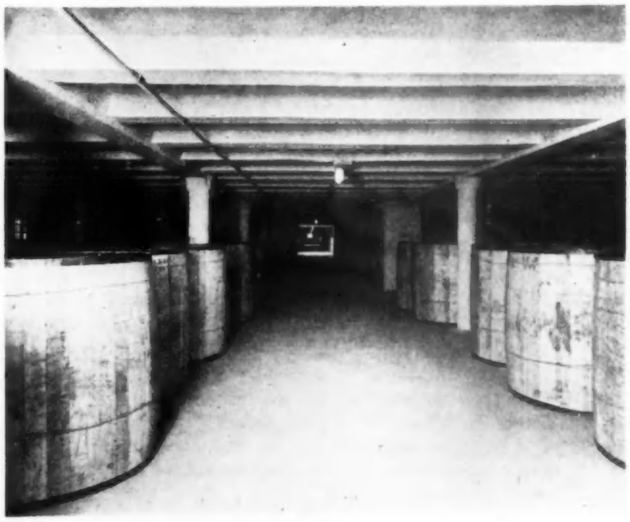


Photo by courtesy of the Mersey Docks and Harbour Board.

Interior view of one of the 13 floors of the Stanley Dock Tobacco Warehouse. Note modern lighting, light colour on walls, stanchions and ceiling, overhead sprinkler, fire proof doors, and smooth floor surface and numbered bays.

The floors should be permanently marked off in areas for record purposes and to facilitate the rapid identification of cargo when warehoused, by reference to the stock books.

Where floors are worked independently, each floor should be provided with its own office, but the main office for the building should be situated on the ground floor, in a position easily accessible to traders, carmen and other parties interested in the cargo. Each floor should be provided with its own sanitary and washing accommodation.

The floors of modern warehouses should be built strong enough to take the weight of mechanical runabouts, pilers, and, in some cases, mobile cranes (mobile cranes can only be used where there is sufficient headroom). Many warehouses, particularly those used for the storage of heavy packages, are fitted with travelling overhead cranes suspended from runways. When this is the case, pilers and mobile cranes are rarely required and, in consequence, the manœuvring space which would be required by them is freed for storage purposes.

Warehouse floors should be well drained, to facilitate washing down and cleaning.

Fire Fighting

Fire fighting facilities should be provided in all warehouses in the form of easily accessible chemical extinguishers, water

Port Operation—continued

hydrants, hose and connections which the staff have been trained to handle in the event of fire, pending the arrival of the fire brigade. Modern warehouses are fitted almost invariably on each floor with overhead sprinklers, which can be turned on when required, or which in some cases operate automatically when the temperature rises above a certain height. Both types of sprinklers should be subject to control from a distance. Warehouses should be designed so that they can be divided into compartments by means of fireproof doors or bulkheads, which will enable affected areas to be sealed off should fire break out.

(To be continued)

Additional Reading.
Port Economics—Brysson Cunningham, Chapters I, II, IV.
Dock Engineering—Brysson Cunningham, Chapters I, II, VI, VIII (General Principles only).
Dock Development—McElwee, Chapters IV, V.

Fenders and Jetties

By R. R. MINIKIN.

Adverting to articles which I have had the honour to subscribe on "Fenders and Jetties," published in the *Dock and Harbour Authority*, and the questionnaire which I submitted to many Port Authorities in all parts of the world, through the courtesy and assistance of the Editor, I have received communications and data which, though not yet complete, as replies still come in, will prove of great interest to harbour engineers.

It will be helpful to recall that the questionnaire had reference to the collection of data of the physical effects and behaviour of vessels coming alongside a jetty. The end in view was to arrive at some definite and practical basis for design assumptions. Hitherto, in the main, these have been mostly hypothetical. The principal points are:—

Approach velocity normal to line of jetty.
Angle of approach to jetty face.
The behaviour of vessel after first contact.
The physical reaction of structure under impact.

The responses to my enquiries have been most gratifying and come from important harbours at home, in Europe, India, Australia, South Africa and Canada. Of the forty-nine recorded observations received, I am given to understand that several items are applicable to a number of similar vessels at the same jetty. However, the following table of approach velocities, normal to the face of the jetty for the last 10 feet of travel, is based on the forty-nine records only.

No. of Vessels.	Approach velocity inches per second.	Percentage of total.
1	25-in.	2%
3	9-in.—12-in.	6%
2	6-in.— 9-in.	4%
7	4-in.— 6-in.	14%
36	2½-in.— 4-in.	74%

It is to be noted that the approach velocity of the larger vessels is normally less than that of the smaller vessels. Two instances of vessels of 25,000 tons give only 3-in. to 4-in. per sec.; and of seven vessels, in the range of 11,000 to 16,000 tons, 5-in. to 7-in. per sec. The most erratic vessels are of the single screw cargo type, which show several instances of high approach velocities, one colliding with fenders at 25-in. per sec.; fortunately it contacted floating fenders at an angle of 30° to the face of jetty and sheered off. It was a vessel of 1,000 tons only. The few cases of 9-in. to 12-in. per sec. occurred on the Thames, Melbourne and Durban, and were cargo vessels of 8,000 to 9,000 tons. One interesting feature regarding single screw vessels of 700 to 1,000 tons coming alongside at velocities of 5-in. to 8-in. per sec. is that the line of their approach is at a steeper angle than the larger vessels, and that they usually sheered off after first contact, progressing a short distance ahead, then swinging to broadside on.

One vessel of 14,700 tons, at the Station Pier, Melbourne, approached at 8-in. per sec., contacted floating fender near the end, deflected fender and fender pile 12-in., and broke face pile; but then rebounded 36-in. from the fender (floating) and swung to broadside. Opposed to this, at the same berth, a vessel of 25,500 tons drew alongside at 6-in. per sec., almost parallel to jetty, causing a fender pile deflection of 3-in. only. Again, at the same jetty, a cargo vessel of 7,000 tons, approaching at an angle of 10° to the face of fenders at 3½-in. per sec., struck a glancing blow on floating fenders and sheered off a distance of 5 feet.

At the South Quay, No. 2, in Madras Harbour, vessels usually approach at the steep angle of 30° to 45°, but the approach velocity normal to the face of quay is only 2-in. to 3-in. per sec. After the first contact, which causes them to sheer off at the bows and swing to broadside, they close into their berths comfortably. In this harbour, which is subject during cyclonic conditions to heavy ranging of the amplitude of 3-ft. 6-in., severe punishment to the fendering system takes place. The harbour authorities have therefore provided a very substantial system of fendering. The fender piles A, fig. 1, are 15-in. square, driven 6-ft. into the sea bed, and bolted to the underside of deck at the head. From low water level to the head of the piles, a timber facing of 12-in. x 12-in. logs (B) are bolted, separated by 10-in. x 3-in. planks. These timbers are 30-ft. long, covering three bents. At the back of A, timber baulks (D), 12-in. x 12-in., are placed to cushion up against the reinforced concrete members of the main structure, which combines substantially dimensioned reinforced concrete raking struts (C), at 45° to the vertical, to take the thrust from the impact. To minimise the pounding on fenders, and to avoid damage to vessels from the ranging, brush wood fenders are also suspended from the deck of the pier.

I am indebted to M. Pierre D. Cot, Ingénieur des Ponts et Chaussées of the Port of le Havre for the following information regarding a successful fendering system for large vessels. He is now busy with the reconstruction of the quays at Havre, and, in this connection, he further informs me that the "Quai de la Floride" at le Havre, which I described in an article on "Fenders and Dolphins," p. 228, January, 1947, in the *Dock and Harbour Authority*, were destroyed by the German Army. Apparently, whilst the *Normandie* had never used this berth, it had been used satisfactorily by vessels of 45,000 tons.

M. Cot further says that the engineers of the Port of Bordeaux, in 1933, designed and manufactured a form of fender for use on the Verdon Pier, at the mouth of the River Gironde, where the swell entering the estuary may reach an amplitude of no less than 10 feet. This fendering is of the suspended type (fig. 2). It is hinged at the top on a substantial single trunnion and weighs about 31 tons; the centre of gravity being 15.86 feet below the axis of the trunnion at low tide and 15-ft. below at high tide. The unit is constructed of mild steel and packed and sheathed with tough timber (figs. 2 and 3). At Verdon Pier they were placed at 100-ft. centres. The maximum projection of the face of the fender from the pier deck is 18-ft. 6-in. in the position of rest; and at maximum compression, it is reduced to 15-ft.

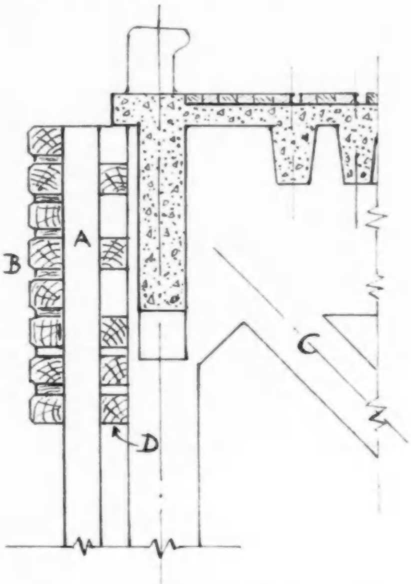
At le Havre it is proposed to fit the apparatus in the quay wall with a rest position having a maximum projection of 5-ft. 3-in. and a fully retracted projection of 1-ft. 7½-in. from the quay face.

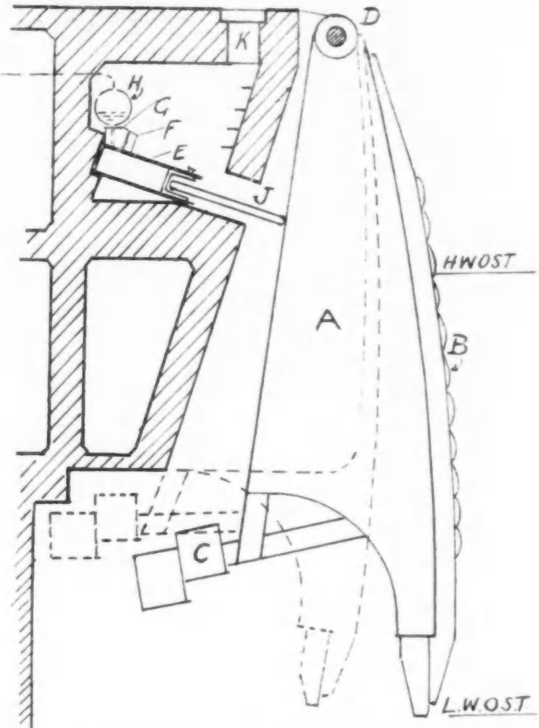
The section, fig. 2, shows the apparatus as fitted at Verdon Pier; A is the body of the fender; B the timber chafing cushions; and C are balance weights. The cross section, fig. 3, through the trunnion, shows how the timber packing of the body is placed; and further shows at L the hard wood sheathing on the outside of the body A. On the inner face of the reinforced concrete cheeks of the main structure, hard wood rubbing strips M are secured. These are fitted to restrain lateral movement under a glancing blow and have proved satisfactory. The reinforced concrete cheeks are 20-in. thick, increasing to 30-in. thick under the trunnion bearings.

To assist the pendulum gravity action of the fender, an oil dash pot E (fig. 2) is connected to the back of A by the heavy steel rod J. The initial pressure in the dash pot is zero and the apparatus is designed to withstand a maximum pressure of 2,500 lbs. per sq. in. The cylinder E of the dash pot is fitted with

Fenders and Jetties—continued

two valves F and G in communication with the spherical oil reservoir H. When pressure is applied to the fender A, the piston forces the oil out of the cylinder E, through the valve F into the reservoir H. When pressure is released and the fender A falls back under gravity, the piston is withdrawn and drains back the oil through the valve G into the cylinder. The valve F is readily adjusted, in a few moments, for pressures to be expected, for size of vessel, and conditions of weather. I am assured that





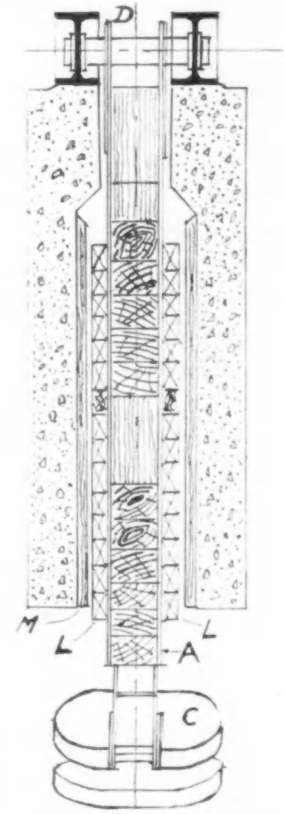


Fig. 1 (left). Jetty Fendering—Madras.

Fig. 2 (centre). Verdon Pier—Suspended Fender.

Fig. 3 (right). Verdon Pier. Cross-section through Fender.

this attention has not given rise to any practical obstacle in its use. The access to the valve chamber is provided by a manhole K in the deck of the pier.

The computed absorption of kinetic energy of each unit of the Verdon Pier on the River Gironde is 2,700 tons, inches, whilst those proposed by M. Cot for le Havre will be 4,800 tons, inches, per unit. For new construction, the concentrated impact allowance for the unit is assumed to be a force of 175 tons. This is based on the practical results of the Verdon Pier. Observations were made under the very adverse conditions of continual bumping of vessels in the heavy swell entering the river. It should be noted, nevertheless, that only a few very large liners have berthed at Verdon.

The dash pot apparatus is a patented device of the S.I.M.E.C., but I understand that no rights are claimed for the combined system. It is the combination of dash-pot and gravity action that conduces to the satisfactory functioning of the unit.

Summary.

From the data so far examined it would seem that the common assumption in engineering offices of an approach velocity of 12-in. per second is on the high side; the majority of observations show that it is more usually under 6-in. per sec. The diversity of the localities of observation and observers, so widely separated as Australia, India, South Africa and Europe, brings into perspective the skilful manœuvring of vessels into their berths. That a small percentage are above this figure does not detract from the conclusion that a velocity of 6-in. per sec., normal to the jetty face, would cover all practical needs for normal conditions. The influence of atmospheric conditions is no doubt great, but is mitigated by the skill and judgment of the pilot, who should, and does, make allowance for these hazards.

However, there is one point on which it would be premature to be dogmatic, and that is the proportion of the kinetic energy of a vessel approaching at a velocity "x" that is absorbed by the jetty. That it is some fraction of the computed energy is established from the results of practical observations and experiment, but what would be a reasonable assessment is so far elusive. The author's model experiments some years ago, which have not yet been resumed, for timber colliding with timber, gave a fraction of 0.27 as a fair amount. However, for steel vessels and reinforced concrete jetties, even with timber fenders, it will undoubtedly be of a greater magnitude. Nevertheless, there is sufficient evidence to show that the fraction is not greater than 0.5 of the vessel's K.E., in quiet waters.

The most damage is caused to jetty structures, not by the magnitude of the energy imparted, but as a consequence of the short time period of the blow, due to a local lack of resilience in the part contacted. This points to the necessity for efficient fendering to prolong the time of blow; absorbing the energy gradually within the capacity of the local structural members to diffuse the forces through the designed channels (graphical system).

When it is definitely certain that no further data is forthcoming, a more conclusive analysis will be made of the records received.

Meanwhile, it is a pleasure for the author to convey his grateful thanks to all the Engineers and Authorities who have collaborated. He is especially grateful to the Chairman of the Madras Port Trust, the Secretary of Melbourne Harbour Trust, and the General Manager of the South African Railways and Harbours, for complete and extensive information.

Any further information which engineers or authorities have not yet forwarded will be welcomed by the author, or editor of *The Dock and Harbour Authority*.

Editor's Note.—The Editor would like to take this opportunity of associating himself with the expression of thanks to all those engineers and authorities who have so kindly contributed the useful data in response to the joint request of Mr. Minikin and this Journal. Problems of construction and maintenance, such as those outlined in the above article, can only be satisfactorily solved by a pooling of practical experience.

The Costing of Dockside Traffic Operations

By J. A. PHILPOTT, A.L.A.A., A.C.I.S., A.M.Inst.T.

(Concluded from page 19).

Cranage

The first question to be decided in the case of cranage is whether the Ship Account is to be charged with the cost of operating the particular cranes which handle its cargo or, alternatively, whether cranage is to be regarded as a departmental service, the charge for which is based on an overall cost per hour or per lift for all cranes similar in type. In the latter case the cost can be comprehensive and include the wages of drivers and crane attendants, power, stores, repairs and wear and tear. If the cost of operating specific cranes is allocated to the Ship Account the incidence of repairs is liable to upset comparisons between ships in different periods and at other berths. As the aim is to test the efficiency of traffic operations the comprehensive average charge is to be preferred for the present purpose. The efficiency of the crane itself as an economic unit is another matter and individual costing, particularly in regard to repairs and cost of power, is desirable as a factor in determining whether the crane is fit to remain in service. Another consideration favourable to an average overall charge is the fact that only a proportion of cranage operations is covered by the port rates for handling goods and the remaining revenue is derived from special hire by stevedores and others at rates which should compare reasonably with the overall cost of operation. There is therefore uniformity and simplicity in charging out the overall average cost to the Ship Accounts.

In so far as repairs are concerned a third view is worth consideration. If cranes are regarded as landlord's capital and part of the port equipment the use of which, with quays, waterways, transit sheds, etc., is covered by the payment of dues, then all repairs can be thrown into the General Maintenance Account and not charged to the Traffic Department. In favour of this view is the fact that under Rating law the cranes are regarded as landlord's capital and part of the equipment necessary to handle a ship and its cargo. Cranes, however, are used for many purposes unrelated to services covered by dues and by hirers who do not pay dues; in these cases the user should certainly pay his share of the cost of repairs and maintenance.

A daily Crane Return is the source of information showing for each crane the number of hours in use, the work performed, and details of delays, breakdowns, late starts and early finishes. If used for heavy lifts where the charge to the user will be per lift and not per hour the weight of each lift should also be shown. The cost of maintenance and repairs will come from the wages analysis plus stores requisitions, or possibly from a contractors bill. How the cost of power is allocated will depend very largely on local circumstances and the type of crane concerned. For electric cranes the problem is easy if there is a metered supply, but if not then an estimate of current consumption can probably be made on a formula devised by the engineer. Where hydraulic power is used the engineer's allocation of power consumed can be accepted if the hydraulic system is used for purposes other than for cranes. Steam cranes offer no special difficulty.

The Crane Account will bring together all expenditure analysed under suitable headings for each class of crane, special duty cranes, such as floating cranes being treated separately. From this will be calculated the cost per hour and per lift for each item in the account. Using these results the Ship Account can now be debited with the cost of cranage which will be per hour for ordinary goods and per lift for heavy packages. A moving average rate based on, say, the previous six months is better than the exact current cost as this will avoid delay in the completion of the Ship Account and even out the effects of special expenditure such as major overhauls.

Shunting

As with cranage, the rate structure has to be borne in mind when determining the extent and nature of the costing procedures for shunting operations. A large proportion of truck movements will be covered by the port rates for handling goods, others will be recoverable in a separate charge either to tenants or other dock users, and the remainder will be at the cost of the port authority. A non-railway owned port is assumed and where it is necessary to make transfers between the dock railway network and companies' lines.

The working costs comprise totals and details of wages, stores and repairs and can be expressed per engine hour, per ton hauled and per wagon hauled. All three expressions are necessary from a costing angle, but cannot by any means be relied upon as a test of the efficiency of the railway department. There can be very wide fluctuations in tonnage hauled without any appreciable effect on total expenditure and the law of increasing returns has nowhere a better example. Consequently it is better to look, not to cost alone, but also to tonnage hauled per engine hour, wagons hauled per engine hour and tons per wagon hauled as measures of efficient activity. Ton-miles are, of course, wholly impracticable on a dock estate either as a test of activity or a basis for costs.

In a general cargo port it is a difficult matter to arrive at separate shunting costs for each class of traffic, but the composition of a train load does nevertheless greatly affect the working costs per ton. The load factors for timber and tank cars are, for example, vastly different and if one class of traffic is preponderant on a particular route it is desirable to attempt a division if costs per ton are to have any meaning at all. A periodic special test is one way of doing this and weighing is another. This applies also to tenants traffic as distinct from ordinary port traffic since there is frequently a difference in operation between the one case and the other. Taken altogether, shunting operations provide some interesting costing problems, some of which can only be solved with exactitude at disproportionate expense. It will, therefore, generally be sufficient to build up costs on a basis consistent through successive periods and in so far as special tests and weighting have not accounted for differences to endeavour to find an explanation in an examination of working conditions.

Expenditure in the railway department will include not only locomotive working, signalling, and working junctions, but also the cost of working with capstans and shunting tractors. The proportion which these last two items bear to locomotive working is always an interesting comparison and may disclose idle time and unremunerative working. All items of expenditure can be expressed in pence per ton in addition to the other comparisons already noted, viz., per engine hour, per ton hauled and per wagon hauled. The ratio of each item to total expenditure is also important and all these comparisons taken together, each throwing light on the other, will enable fairly accurate conclusions to be drawn on the efficiency of the department.

The statistical information necessary to supplement the financial details will include a Location Report showing the route allotted to each engine and the number of hours under steam indicating also the nature of the duty, i.e., day, night or late night engine; from consignment notes, orders, etc., will be obtained an analysis of tonnage hauled to and from companies' lines, internal shunting and tenants' traffic, showing in every case the class of traffic handled under the various trade headings and whether covered by the port rates or recoverable as a separate charge.

The treatment of repairs requires special consideration if undue fluctuations in operating costs are to be avoided. Track maintenance is not necessarily wholly a traffic department charge and lines would have to be provided and maintained even though the port authority did not itself engage in labourage operations. The traffic hauled will include also goods handled by stevedores, contractors, tenants and others and there is no reason why they should not pay their share of maintenance in the rates charged

Costing of Dockside Traffic Operations—continued

to them. Good principle favours an all-inclusive cost, but it is rather a matter for policy to determine and complications are avoided if track maintenance is treated as part of general port maintenance, leaving the Shunting Account to be debited only with operational costs and repairs to rolling stock. The latter costs can at times be sufficiently heavy to distort comparisons between one period and another unless charged out through the medium of a special account. This would be operated by debiting thereto all repairs as they occur and transferring to the Shunting Account an equalised figure representing the average expenditure over a period of years. Where experience shows this to be desirable the period selected should be sufficiently long to equalise the cost of infrequent and heavy repairs.

The next consideration is the charge for fuel consumed. How this is measured will depend in part on the coal yard arrangements, including the number of stacks and whether or not the same supplies are used for other purposes. A perfectly stacked coal yard with measured walls and floors and the most orderly withdrawals of supplies would, in theory, enable the quantity consumed to be declared with some accuracy. Actual conditions do not always favour such ideal arrangements and it is advisable to test consumption in at least two ways. In these days of control and minimum stocks a coal yard estimate is easier to obtain, and if this is considered in relation to a computation based on the number of light-ups and the number of hours under steam, a fairly accurate charge can be determined. The grade of coal available will probably make it necessary to vary the multiplying factors from time to time.

With the addition of a charge for wear and tear and for establishment the material is now available for calculating the cost per ton for each of the classes of traffic for which separate costs are desired. The method of dealing with establishment charges will be noticed in a later paragraph.

The amount to be debited to the Ship Account for shunting can be computed from the material provided in the Shunting Account itself together with its relevant statistical information. The transfer will be based on the weighted cost per ton hauled to or from the ship and will eliminate from the Shunting Account all traffic the cost of which is recovered in the port labourage rates. After all ships have been dealt with in this way the remainder in the Shunting Account will represent the cost of handling traffic for tenants, contractors and others and will be set against the special revenue obtained from these sources. At some ports additional revenue may be derived from work done for the main line railway companies, such as cleaning and sheeting trucks, or certain terminal services. Needless to say, each source of revenue should have its counterpart in the costing records and the margin between revenue and costs kept constantly under review.

The use of self-propelled trucks in ship-side operations provides no special costing problems being merely wages, plus repairs, fuel, battery-charging and wear and tear, all of which is expressed in a cost per hour. Their peculiar feature is how they sometimes desert their primary functions and fail to increase output or to save labour. Consequently, a comparison between holds and ships is informative and sometimes something can be done about the differences. But the examination in other cases can be just as inconclusive as trying to find out why one gang will stop for 90 minutes for a storm of rain whilst another in the same area is content with an hour.

Overhead Charges

The distribution of traffic department overhead charges between the various trades and services has no obvious solution. The alternatives include (a) not to distribute, (b) to make an apportionment on the basis of expenditure incurred monthly under each heading. (c) to adopt a moving percentage based on the ratio of expenditure during a previous period, say, six months, (d) to substitute tonnage handled for expenditure in (b) or (c), or (e) a ratio based on the budget estimates of expenditure for the year. Many other variations will doubtless occur to the mind. Alternative (a) is not very commendable since it savours of an attempt to avoid an awkward problem. In principle there is nothing wrong in an apportionment based on expenditure or tonnage ratios, but in practice this leads to steady traffics taking a fluctuating share merely because of a rise or fall in other imports or exports. On the whole a compromise is advisable and this can be made by allotting to each trade and service a fixed minimum figure based on experience and to add to this a share of the excess overheads above the total minima in the ratio of total expenditure. The fixed minima can be arranged at, say, 80 per cent. of the total and reviewed annually when the budget estimates are made.

A difficulty will arise in making allocations to individual Ship Accounts if their completion is not to be delayed until the end of the month. This can be overcome through the medium of a Distribution Account which will carry the whole of the trade allocation of departmental overheads and be credited with each allocation made to the Ship Accounts. A percentage on wages, adjusted to current experience, is the easiest method of allocation. Any balance remaining in the Distribution Account will be the measure of under or over-estimates and can be kept within a narrow margin.

The foregoing remarks apply only to departmental overheads and not to the percentage addition for establishment made to accounts for services rendered on a cost basis as distinct from a schedule rate. Custom and tradition tend to make this a standard percentage which is rarely altered, but in these days of increasing social legislation and improvements in welfare and working conditions a periodic review is very necessary. Better still, a monthly summary of all items included under the heading of Establishment can be prepared with very little trouble and expressed as a percentage of total expenditure. A fluctuating percentage addition to accounts recoverable on a cost plus profit basis is not altogether acceptable but if the increase is firm or tends to rise then an adjustment should be made. The usual predilection is to fix this figure on a long-term basis.

Presentation of Results

When the Ship Account has been completed it can be presented in the following ways:

(i) A financial statement showing under trade headings the cost of each operation, the revenue received from port rates and for subsidiary services, and the balance of profit or loss.

(ii) A statement showing the quantity and cost per ton of handling each class of goods under the various methods of delivery, e.g., ex-ship to truck, lorry, craft or store.

(iii) A statement showing the output per gang for each class of goods handled.

Added value is given to the above information if results are carried to a summary to aid comparisons by tabular or graphical presentation. The discovery of trends and variations is one of the most important features of costing and various methods of presentation can be used to this end. A very useful form of presentation is to plot on one graph four curves representing respectively the cost of handling each ton of goods discharged ex-ship to truck, lorry, craft and store. The vertical scale would show the cost in pence and the horizontal markings would indicate the vessel by name and show also the quantity discharged and the berth concerned. A separate graph would be plotted for each type of cargo. A study of the graph would disclose, for example, any consistency in the results obtained at a particular berth which might be above or below the average, or it might reflect the relative efficiency of supervision at the various points. Any case wide of the average would call for immediate comment and should lead to a close examination of the ship's account.

Another feature to be observed would be the suitability of a berth for particular operations, e.g., a below average cost would be expected for ex-ship to truck operations at a berth where the lay-out of sidings facilities the movement in of empty trucks and the rapid withdrawal of those loaded; in the contrary case a bottleneck in sidings leading to and from a berth would inevitably be reflected in slower working and higher costs. The type of crane, width of quay, number of tracks, provision of capstans, these and many other features affect the working results at each berth and

Costing of Dockside Traffic Operations—continued

the graphical presentation of costs brings out these variations more clearly than tabular statements of figures. To these permanent features would be added the variations arising from circumstances relating to the ship itself, such as bad stowages, mixed marks, stress of weather and the breakdown of ship's gear.

In the graph described it would be useful also to draw across the page a dotted line to represent for each of the curves the average for the preceding year, or alternatively, the revenue curve. As previously mentioned, so many circumstances can combine to make a profit or a loss, even where similar cargoes are being worked, that it is always interesting to discover the cause of the one or the other and whether traceable to the ship, the berth, labour, gear or just good or bad management.

Where homogeneous cargoes are concerned a graph showing the percentage of expenses to revenue is of particular interest and this type is suitable also for representing operational results in the case of shunting, cranage and other specialised services.

The method of presenting results cannot be too strongly stressed as there is always a danger that a Cost Department will produce a mass of figures which, whilst necessary and informative, is too much for a busy management to digest. For the latter, the salient facts and brief notes are required, but the executives in the operating departments should have need for, and have presented to them, the most detailed costs and analysis of expenditure that the Costs Department can economically provide. It is, therefore, well worth while to plan a series of graphs and diagrams that will give the management a bird's-eye view of all operations without asking them to plod through tedious columns of figures. The detail should, however, be available and if necessary cross-referenced from the diagrams. All trends should be related to a datum or base which is best represented by **100**. If in our present trouble we regard **1938** as the golden age of our dreams then with this as 100, one sheet of paper can carry an index of every phrase of dock activity and its principal financial and costing results.

As one of the objects of costing is to encourage efficiency by discovering and eliminating weaknesses there is everything to be said for taking the outside staff into your confidence and supplying the foreman and others directly responsible for working a ship or service with a statement showing the costing results of their efforts. This is particularly desirable where a new rate has been built up and the outside staff have been allowed some discretion in engaging the labour force necessary to handle the traffic under conditions which may be very different from those visualised before the vessel arrived. To keep them informed is to give them, as it were, a target to aim at on every occasion and is much more likely to secure good results than if, as so often happens, costs are treated as purely an office matter.

The Comprehensive View

When the Costs Department has done its best with the microscope it is a relief to turn to a number of very broad tests which can be applied to the undertaking as a whole. Basically, a port exists to handle goods and passengers and the whole of its labour force, including maintenance, has as its ultimate object the efficient movement of this traffic. Allowing for an adjustment in respect of passenger traffic one test to apply is to ascertain separately the ratio of man-hours and wages to the total quantity of goods passing through the port. A comparison with a pre-war year will be revealing and will probably bear no relation at all to the known increase in wage rates since that time. This is likely to be true of almost every industry to-day, but it is helpful to know the extent of the deterioration that has taken place. A little wistful speculation on how much charges could be reduced if the old standard returned is not entirely a lost effort.

Another over-all comparison is to express in pence per net register ton of vessels arriving the cost of all items comprised in maintenance, dredging, conservancy, nautical work and general administration. An adjustment for maintenance deferred owing to the war would be necessary. In very broad terms tests such as these, and there are many more, disclose what may be regarded more as economic trends than as costs from an accountant's point of view and that is precisely their value in the work of administration. The management have an interest in the wood and the trees and the wider view is a corrective to the spotlight.

The Future of Inland Water Transport*

By W. FRASER, Secretary and Traffic Manager,
Trent Navigation Company

It would be foolish to tell transport experts that the successful future of the inland waterways demands the expenditure of colossal sums of money for the provision throughout England of various ship canals capable of receiving ocean-going steamers. Nor can I advocate, with any conviction, such a grandiose scheme as the much publicised Grand Contour Canal. I would not even go so far as to say that inland waterways in England can be developed to that standard of navigation which obtains abroad; for they can never assume, in this small and hilly country, the importance which they attain in Europe or in America. Their vertical rise per mile is much greater in Britain and necessitates a multiplicity of locks; but copious supplies of water are not always available to enable large locks of standard dimensions to be built on all waterways. Hence, unlike the railways, the track lacks that uniformity of gauge which could permit craft starting at any point in the country proceeding without transhipment to any other point.

In my view, the future successful development of inland waterway traffic will be confined to those navigations which do or can provide efficiently a track capable of passing estuarial craft. This view seems to be in accord with that of the present Government. The Transport Bill, as introduced to the House of Commons on 28th November, 1946, makes provision for the establishment of Executives whose function will be to assist the British Transport Commission in the exercise of their powers to provide an efficient, adequate, economical and properly integrated system of public inland transport and port facilities within the country. The Bill states that one of the Executives will be designated the "Docks & Inland Waterways Executive." Presumably, therefore, the inland waterways, together with the docks, will be operated as one consolidated service, functioning in harmony with other forms of transport and, let us hope, with efficiency and a low real cost.

Recent Developments

The development of the Trent Navigation shows clearly the reason why emphasis is laid on the importance of creating waterways which permit the passage of dock or estuarial craft. Under the guidance and direction of the late Lt. Col. Frank Rayner, considerable new navigation works were carried out between the two wars by the Nottingham Corporation—five new locks between Nottingham and the sea and three new low-crest weirs were erected, and much dredging was executed. Prior to **1921**, when the work was begun, standard Trent boats were unable to pass fully-laden south of Newark, and transhipment of goods to upper-Trent lighters of shallow draught had to take place. This intermediate handling cost money and caused irritating delays to urgently wanted cargoes. Traffic on the navigation was declining and the growing pressure of road transport competition was becoming a fearsome menace to the waterway carriers.

The new locks and weirs were completed by 1928. They constitute a permanent memorial, massive in size and pregnant with utility, to the foresight and genius of Col. Rayner. The locks are **200**-ft. long by **30**-ft. wide and accommodate four standard Trent craft. Such boats operate in Hull as lock lighters, receiving and delivering goods direct alongside steamer. The non-self propelled units carry **140** tons of dead-weight cargo each, and the power boats **100** tons, so that the usual flotilla, consisting of one power boat and three dumb boats, can carry over **500** tons. The locks thus have a capacity of **500** tons at each pen.

Since **1928**, standard Trent boats are able to voyage at all times of the year from the docks in the Humber ports to Nottingham. During this period, the capacity of the carrying fleets on the river increased by about fifty per cent.; not by a planned development, but on the initiative of the carriers concerned to take advantage of the improved waterway.

*Paper read before the East Midland Section of the Institute of Transport on 12th December, 1946, and reproduced by permission.

Future of Inland Water Transpor.—continued

The traffic conveyed over the Trent in 1927 totalled 375,803 tons, and this increased in 1930 by 44 per cent., in 1933 by 45 per cent., in 1936 by 62 per cent., and in 1939 by 73 per cent. —the total goods carried over the navigation in that year being 675,377 tons. On the section between Newark and Nottingham, the figures speak more eloquently of the success of the improved navigation, there being an increase of a quarter of a million tons in 1938 as compared with the year 1928, i.e., a ten-fold expansion of traffic.

A 250 ton boat in a lock on the Trent Navigation System.

Canals Reduce Handling Costs

It should be remembered that during this period of continuous and substantial expansion, the inland waterway carriers were exposed to the full brunt of keen and unparalleled competition in rates and service from road and rail, and it is suggested that on the record as disclosed, only one conclusion is possible—the movement of goods in estuarial craft is cheap, reliable and efficient, and should be developed in the national interest wherever physical conditions permit.

As the economy of this small island is dependent on imports and exports, efficient ports and harbours are essential to our well-being. We must ever seek for greater efficiency in handling cargoes to and from ocean-going vessels. Experience shows that with prudent planning and co-ordinated effort the costs of importing and exporting goods can be reduced, and the greater use of existing waterways and of improved and extended navigations can make no small contribution towards this desirable objective.

From time immemorial, ocean-going ships have used small boats for the discharge of their cargoes. This procedure was rendered necessary originally because proper quays and docks were not available and ships had to lie at anchor off-shore in safe and protected harbours, where the only possible means of loading and discharge was through the medium of the ship's own derricks, direct overside to estuarial craft. In the course of time, expensive harbour accommodation was constructed, and, to recompense the capital therein employed and also to ensure adequate maintenance of its works and equipment, dock dues were imposed on ocean-going ships. The heavy incidence of these dock dues and rents has created an inducement to arrange the turn-round of a ship in the smallest possible time.

Quicker Turn-Round of Shipping

It is a fact that vessels are turned round more speedily and a far greater tonnage is handled per day when loading or discharge is made to estuarial craft and to quays simultaneously. While the permanent equipment on the quayside is engaged in unloading goods to land and to barges moored under the bow and stern, the ship's own derricks are employed in a like operation to estuarial craft on the seaward side of the vessel. Congestion on the quay is minimised. Shipping space is economised. Costs are reduced.

For work in the ports, estuarial boats have natural advantages of their own as compared with other forms of inland transport. They have the ability to load and unload goods at steamers without the use of the wharves or unloading gear at the docks or even, in an emergency, without the necessity for a ship to go into the docks at all. Having been placed alongside a steamer, only three small movements of craft are necessary before loading or unloading is completed. Such movements occupy only a few minutes and are effected by slackening or tightening mooring ropes when either end or middle hold of a boat is worked. In the case of average general merchandise cargo, 30 tons is held in each end and 40 tons in the middle of the hold of an estuarial boat and, therefore, at least 30 tons of cargo can be loaded without a break for movement of transport. On the other hand, the average tonnage conveyed by a railway wagon at the port is 7.32 and, after this quantity has been handled, some delay occurs whilst another wagon is shunted into position. These delays occur likewise when motor vehicles are used. Furthermore, the actual handling, including stowing, of the cargo is a more speedy operation in estuarial boats, for there is ample room for men to keep out of danger and adequate space for the cargo to be easily manipulated, whereas on the restricted platforms of rail and road vehicles great care must be exercised, especially in lowering goods.

All these considerable advantages are exploited fully at present in Hull, but the full saving in costs to importers is not achieved because far too many of the estuarial boats, when loaded, are moved but a distance of a few yards in the same dock or, at most, a few miles to another dock, where the cargo is discharged again to rail trucks or road vehicles for ultimate despatch inland. An unnecessary extra handling of goods is introduced. For every hundred tons imported in Hull, sixty tons are discharged direct overside from ocean-going steamer to port lighters and river craft, but only eighteen tons are forwarded by inland waterways. Yet it is the natural and more economical procedure for the small craft to be despatched inland intact. In one sense, a town like

Power Boat and 3 Dumb Boats navigating at Newark on Trent.

Nottingham should be regarded at the extremity of a long extended arm of the docks of the Humber ports with the river craft acting as dock lighters. Would not Leicester benefit by being in a like position? This is even more so in the case of Gainsborough, which is on the tidal part of the river, for boats often get there and back on the tide without using any motive power. Such increased usage of the waterways must reflect itself in reduced import charges. Surely here is an opportunity for the British Transport Commission and the proposed "Docks & Inland Waterways Executive" to

Future of Inland Water Transport—continued

exercise their powers to provide an efficient and economical service which will afford profit to the nation.

Suggested Improvements

A first task would be to ensure that where physical traffic and hydraulic considerations allow, the net-work of inland waterways is brought up to that standard of navigation efficiency which will permit the passage of estuarial boats.

In the case of the Trent Valley area, it is suggested that the Executive might set up an organisation to consolidate and administer the inland waterways therein situated. Having regard to the navigations which form a traffic unit in the region and to the limits indicated by water supply, it seems that the following would form a group which would be convenient and efficient:

The Main River Trent Navigation;
The Fossdyke Navigation, at present controlled by the London & North Eastern Rly. Co.;
The Erewash, Loughborough and Leicester Navigations, at present controlled by the Grand Union Canal Co.;
The Trent & Mersey Canal, from Derwentmouth to Fradley Junction, at present controlled by the London, Midland & Scottish Rly. Co.

To enable estuarial craft to pass on those waterways, improvements will certainly be required.

1. The entrance lock at Torksey, on the Fossdyke Navigation, is not only too short by 8 feet to admit the standard Trent boats, but is too shallow to permit the entrance of vessels drawing 5 feet or more for periods at neap tides, which amount in each year to an average total of about three months. The lock should be lengthened and deepened to avoid these two defects.
2. The navigable Trent between Nottingham and Shardlow, including canals and cuts, should be dredged so as to enable standard Trent boats carrying 100 tons to pass.
3. The Erewash Canal Section of the Grand Union should be developed at least to the gauge of accommodating a standard Trent boat carrying 100 tons at a draught of 5 feet. As the commercial prospects of this waterway depends principally on traffic to and from Stanton, the initial development need not proceed further than the first 5½ miles of canal.
4. The former Leicester and Loughborough Navigations have 18 locks, all of which, except five, are large enough to pass standard Trent boats to a draught of 3-ft. 3-in. It is suggested that the five short locks should be lengthened, that all locks be deepened, and the navigation dredged to permit the passage of standard Trent boats.
5. The Trent & Mersey Canal, as far as Burton, could be improved to the standard required for estuarial craft, but the cost would probably be so great that an alternative route following the Rivers Trent and Tame to Tamworth might show greater benefits to trade and industry.

Unless these improvements are carried out to the water-ways south of Nottingham, it is feared that they will be of little value as traffic arteries to the towns and countryside through which they pass. The craft which use them at present cannot journey in safety to Hull, and their use involves transhipment of cargo. If road delivery away from the waterhead is required at Shardlow, Loughborough or Leicester, it is cheaper to tranship at Newark or Nottingham direct to lorry, rather than to a smaller boat for the intermediate stage of the journey.

The emphasis on the provision of waterways which pass estuarial craft must necessarily prejudice the future of those canals which, because of water supply and other difficulties, cannot be improved to that standard. So be it! Let us face realities. Narrow canal boats cannot operate with safety on the estuaries. They cannot compete economically with modern road transport vehicles. Unless the canals on which they navigate can be and are improved, such navigations will have to be written off as redundant, and can be left to die a natural death. Due to special local conditions, their final extinction may be delayed, and it is not my wish to hasten in any way their dissolution, but most assuredly mortification will eventually set in. Yet for those navigations which permit the passage of estuarial craft, the future is bright—the economy of the country in peace-time and the dire necessities of a state of war demand their re-habilitation and increased user.

The present day trend in industrial relations is towards shorter hours of work. Concomitant with this development the State must assume the obligation of providing amenities to interest and occupy the increasing leisure of the masses. Improved inland waterways can be utilised towards this end. Pleasure traffic is rarely prohibited at the present time but, except in a very few cases, it is not actively encouraged. This is due to the fact that as many water-ways are restricted in size, in depth and in water supply, pleasure boats interfere with and impede commercial craft. But if the programme which I have outlined is followed in each of the valleys of the four major rivers of England—the Severn, Trent, Yorkshire Ouse and Thames—and elsewhere, I can foresee a great increase in commercial and pleasure craft; navigations affording efficient, adequate and economical inland transport in their own particular sphere and, without detriment thereto, giving infinite pleasure and relaxation to the countless thousands of workers who live and work on their banks.

Obituary

We regret to record the death on May 19th of **Mr. Nicholas G. Gedye, O.B.E., M.Inst.C.E.** He was born at Bristol in 1874 and studied at the University of Birmingham where he graduated as B.Sc. Taking service with the late Mr. W. T. Douglas whose assistant he became in 1896, he was engaged on lighthouse construction in the Colonies. Then he was appointed Chief Engineer to the Tyne Improvement Commission, an appointment which he relinquished in 1915. He served as a Lieut.-Col. during the first world war and thereafter became Chief Engineer for docks, harbours and waterways in the Ministry of Transport. He left in 1921 to take up consulting work in Westminster. He acted as British Government representative on the Permanent International Commission of Navigation Congresses. In 1932, he delivered to the Institution of Civil Engineers the Vernon-Harcourt Lecture on the Handling of Coal at Ports.

We also regret to announce the death of **Mr. William Gordon Glover, M.I.M.E., M.I.N.A.,** which occurred on 28th April last. Born on 13th April, 1880, Mr. Glover was educated at Weybridge School, and Fettes College, Edinburgh, and served his engineering apprenticeship with S. & H. Mortons Shipyard, Leith. He studied engineering at University College, London, and served in the South African War, subsequently returning to University College to complete his studies.

On his father's death, Mr. Glover became Joint Manager of the family business, S. & H. Mortons Shipyard, until the 1914-18 War. In 1916, the business was taken over by Messrs. Hawthorns, of Leith, and Mr. Glover joined the Royal Engineers, being gazetted as Captain, and posted to Basra, in Mesopotamia, to design the slipways there and run the dockyard under Col. Ratsay. He was one of the principal figures in the now famous Inland Water Transport system in Mesopotamia.

Returning to England after the war, he became a Consultant on Marine Slipways, gaining an international reputation. He designed slipways for a number of ports throughout the world, among them being Constantinople, Naples, Hong Kong, Nyali and Lorient—the latter incorporating his patent hydraulic bilge-block. At the time of his death, he had just completed designs for a slipway for the Port of Dunkirk.

The Institute of Transport.

Mr. Thomas Wright Royle, C.V.O., M.B.E., M.Inst.T., has been elected President of the Institute of Transport for the year 1947-48, and will take office on October 1st, 1947.

Mr. Royle is a Vice-President of the L.M.S. Railway, and has been a Vice-President of the Institute of Transport since 1944, having served on the Membership and Examinations, the Finance and the Examinations Committees.

Notes of the Month

Port of Bordeaux Entrance Cleared.

With the refloating of the *Belgrad*, a steamer of 7,000 tons, which was sunk by the Germans when they evacuated the harbour in 1944, the Port of Bordeaux has been completely cleared of wreckage, with the exception of a small fishing vessel which still has to be raised.

Development of the Port of Hobart, Tasmania.

Plans recently announced for the future development of the Port of Hobart provide for the replacement of the existing King's Pier and Queen's Pier by one double pier 340-ft. wide with two berths 700-ft. in length; the removal of Ocean Pier, and the enlargement of wharves and other facilities to provide accommodation for liners of up to 30,000 n.r. tons.

Savannah Harbour Improvements.

Following the approval of an appropriation of $1,000,000 for the improvement of the harbour of Savannah, Georgia, the U.S. Army Corps of Engineers announce that work on the project is to be started in the near future. The improvements contemplated include the dredging of a sand-bar off Tybee Island and the deepening of the channel up-river.

New Dredger for the Port of Madras.

The twin-screw drag suction hopper dredger *Sir Godfrey Armstrong*, which has been constructed by Messrs. Wm. Simons & Co., Ltd., to the order of the Madras Port Trust, was launched last month at Renfrew, Scotland. The new dredger, which is to replace the one built in 1904 by the same contractors, is 198-ft. in length, 37-ft. in breadth and 15¼-ft. in depth. The hopper has a capacity of 18,520 cu. ft., and the propelling machinery consists of two sets of triple-expansion steam engines.

Southampton's Heavier Passenger Traffic.

The revival in oversea travel is reflected in statistics just published by the Southern Railway for Southampton Docks for the first four months of this year. Nearly 100,000 ocean and cross-Channel passengers were dealt with, which shows increases of 18 per cent. and 16 per cent. over the corresponding period of 1946 and 1938 respectively. There was also an advance of 10 per cent. in the cargo traffic over the first four months of 1946.

The Tees Development Plan.

It was announced at a recent meeting of the Tees Conservancy Commission at Middlesbrough that authority had been received to proceed with the construction of oil and coal berths at an estimated cost of £328,630. The whole of the proposed developments are not taking shape as rapidly as had been hoped, because of difficulties over priorities. The Commission, however, are not to relax their pressure for the implementation of the full scheme, which includes docks, for this represented an integral part of the plan for the diversification of industry in an area which had suffered so grievously from unemployment in the past.

Jarrow Dock to be used for Repair Work.

As the result of negotiations concluded between Sir John Jarvis, M.P., and the Government, it was agreed that Jarrow Dock will in future be used for ship-repair work. This decision, which will ensure continuity of work for several hundred men since they began naval repairs during the war, ends a long period of uncertainty. Last year, workmen protested against the threatened closure of the dock to ship-repairing. Palmers Hebburn Company, Ltd., carried on throughout the war and will assume responsibility for the actual repair work at the dock in future years. Making the announcement, Sir John Jarvis said, "after considerable discussion I have agreed to the transfer indefinitely to the Board of Trade. It means a sacrifice for us, but we have other plans for the dockyard (apart from the dock) which will mean even more employment."

Sunderland Dock Appointment.

Captain John Archer Scott has been appointed deputy harbour and dock master at Sunderland. He was appointed assistant harbour master in 1937 and has recently been demobilised after five years' war service with the Royal Navy.

Spanish Ports to Be Modernised.

It is reported that the Spanish Government, through its Ports Works Committees has authorised the necessary expenditure for the modernisation and improvement of the ports of Barcelona, Bilboa, La Coruna, Cartagena, Malaga and Santa Cruz.

Improvement at the Port of Vera Cruz.

Vera Cruz, one of the leading ports of Mexico, is to be further improved with the construction of ten additional wharves. The work, which will be supervised by the Mexican Ministry of Marine, is expected to take four years to complete.

Portaferry Harbour.

Negotiations are in progress between the Down County Council and the owners of Portaferry Harbour, Northern Ireland, for the transfer of the undertaking to the Council. The harbour is used for the unloading of coal cargoes and the export of potatoes, and it is estimated that essential repairs will cost approximately £6,000. Towards this the Northern Ireland Government is prepared to contribute £3,000.

Mersey Docks Marine Surveyor.

At a recent meeting of the Mersey Docks and Harbour Board, the chairman of the Marine Committee referred to the retirement of Captain H. V. Hart from the position of marine surveyor and water bailiff, and to the appointment of Commander Harbord as his successor. Captain Hart has been in the Board's service since 1916 after a career of distinction at sea. He became marine surveyor and water bailiff in 1927. Commander Harbord has been assistant marine surveyor since 1922.

Plans for Port of Beira Development.

A technical commission of British and Portuguese engineers are visiting the Port of Beira to study the efficiency of the port and make recommendations for its development so as to keep pace with the requirements of the territories which it serves. After an examination of the problems involved, the members of the commission will report to the Portuguese Government on the adequacy and efficiency of the present port installations, and will submit a comprehensive plan of future port development.

The Port of Stettin.

News has been received from Poland of plans for the development of the newly-acquired port of Szczecin (formerly known as Stettin). It is estimated that over a million-and-a-half tons of goods will be transhipped there during the year, and special arrangements are being made for the victualling of ships calling there. The railways have speeded up the reconstruction of lines and sidings, including new sidings for the petroleum centre in the New Port. Repairs and salvage are proceeding apace and a number of new warehouses have been completed.

St. Lawrence River Development.

Urging Senate ratification of the treaty with Canada for the development of the St. Lawrence River, Mr. Marshall, U.S. Secretary of State, said recently that completion of the project would aid immeasurably in U.S.-Canadian defence of the North American continent. Mr. Marshall said the St. Lawrence project would enable the United States to build ocean-going warships in the relative security of inlaid waters, create a vital line to the industrial heart of the United States, and permit development of power resources comparable with those of the Tennessee Valley and the basins of the Columbia and Colorado rivers.

Radio Aids to Navigation

Application Within Harbour and Coastal Waters*

Safety from Contact with Land, Floating and Fixed Marks

The mariner's principal concern is that at all times the ship should have sufficient water under her keel to proceed in safety. Any movement of a vessel from one place to another can be divided into all or some of the following stages:—

(a) Movement out of the port or anchorage, including passage down a narrow river, channel or estuary, where room to manœuvre is restricted, i.e., " pilotage waters ";
(b) Movement near a coast where land may be in sight or dangerous shallow water in the vicinity, but where room to manœuvre is generally available, i.e., " coastal waters ";
(c) Movement in the open ocean near no immediate dangers, i.e., " ocean passage ";
(d) Approaching the coast, shallow waters and dangers from seaward, i.e., " coastal waters ";
(e) Achieving a safe and timely arrival in the desired harbour, i.e., "pilotage waters."

In all these stages, except " ocean passage," some form of hazard may be in the immediate vicinity and the mariner's principal requirement is that he should know his position *relative* to the hazards in order to avoid them. On the wide open ocean, he requires to know his *geographical* position in terms of latitude and longitude.

The requirements for these different stages can now be considered in detail.

Pilotage Waters.—In these areas, land or shallow water is in close proximity and the mariner is usually required to pass very close to the hazards. Often the water is shallow and in general it is essential to know the ship's position to a high degree of accuracy. This position must also be instantaneously available. The margin of error is small, since room to manœuvre is restricted and the ship can in a short space of time change from a position of safety to one of danger. For the same reasons, it is essential to know that the course the ship is making good is a safe one. The requirements is for an accurate position relative to the dangers.

Coastal Waters.—When in coastal waters, the ship is in more open waters, although land or shallow water may still be in the near vicinity. The mariner has, however, greater freedom of movement. Dangers are not normally so close as in pilotage waters and, within limits, therefore, the prudent navigator is able to allow a certain safety margin when clearing these dangers. The requirements are thus much less stringent and it can be stated that, provided the mariner knows the extent of possible error in his position, he can take this into account in allowing a suitable safety margin. Again, the position required is one relative to the dangers.

Ocean Passage.—In this stage the ship may be out of sight of land and in deep water. In most areas there are no dangers in close proximity. The navigator can allow a reasonable time in which to complete his fix. The mariner requires a position with sufficient accuracy to maintain his desired route, to keep to his time schedule, and to take his ship into the coastal coverage areas at a desired point so as eventually to make an exact landfall.

Application of Existing Aids

While there are no radio aids at present in existence to meet in full these exacting requirements, it is considered that certain systems are sufficiently developed to meet them to a very large extent. Those which most nearly approach the requirements or are capable of being developed in the near future we consider should now be made available to the mariner. We must bear in mind, however, the need for a detailed area analysis before applying these generalisations to any particular part of the world. The mariner is concerned principally with the possibilities of existing aids, but supports the scientist in the development of aids which might have a future application.

In Harbours and Approaches: Pilotage Waters.—The principal requirement in these areas is that the position and track of the ship, relative to the dangers, should be immediately ascertainable. All position fixing systems in use, including visual fixing, involve the obtaining of a position line or position lines by means of an instrument and the transference of these position lines to a chart before the relative position can be obtained; the requirement of position immediately available is difficult to meet. One system which can partly meet that requirement is radar. So long as the dangers are substantially above water, radar will provide an instantaneous relative picture. If the dangers are hidden under the surface of the sea, radar, combined with a Chart Comparison Unit, can also provide a relative picture by direct comparison with the chart, provided that there are sufficient marks (including responders) above water to enable the chart to be lined up with the radar picture; this is often so in the areas under discussion. Radar provides the required accuracy. A position fixing system, such as the Decca system, will also provide the required accuracy and is particularly useful in areas where radar conspicuous marks are few or non-existent, but it cannot provide the track unless fixes are continuously plotted on a chart. Since it can provide the position more quickly than by visual fixing, it is considered that a combination of Decca and radar can meet most of the mariner's requirements in pilotage waters.

In Coastal Waters.—Similar arguments to those given in the preceding paragraph for the use of radar hold good (within radar range) in coastal waters provided that there are sufficient identifiable marks above water to enable a fix to be obtained. In a number of areas in the world, however, the above condition is not present, and we conclude that it will be necessary to use radar in conjunction with one of the position fixing systems in these areas. The time factor is not so important and a short time lag whilst the relative position is obtained is acceptable.

Of the available position fixing systems, Decca can provide the required accuracy over an area great enough to provide coverage economically. The presentation is simple and does not require a skilled operator. We conclude, therefore, that the required aid in coastal waters can be found in a combination of Decca and radar.

Application to Lighthouse, Buoyage and Harbour Authorities

Further problems not immediately connected with the handling of ships, but closely related thereto, arise in laying buoys, dredging channels, checking floating marks, hydrographic surveying, and the locating of broken ends of submarine cables; these cannot always be solved by radar—indeed, numerous marks and dangers in European waters are out of sight of land marks. Further, in Scandinavian and Baltic waters, and also on the Great Lakes, the coming of Spring entails the replacing of many buoys and marks which have been destroyed by ice or winter storms. The use of an accurate position fixing system in this work is of the greatest value and these problems could be largely overcome by the use of a system of the accuracy of Decca.

The Economic Factor.

When summing up the ways in which the mariner's requirements can be met, it is important to take the economic factor into consideration. Mercantile shipowners consider costs very carefully and will not embark on expense in providing special operators, intricate equipment and special services, unless on balance these are shown to effect savings in operating costs.

We conclude that the mariner's requirements are best met by a combination of radar and Decca in pilotage and coastal waters, and that any requirement for an ocean aid might be covered by the use of Consol stations established primarily to assist the navigator.

*** Excerpts from a Paper, giving the views of the United Kingdom Delegation, read at the Second International Meeting on Marine Aids to Navigation, held in the United States of America from 29th April to 9th May, 1947.**